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AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

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Typical Report Citation and Abstract

❶ 19970001126 NASA Langley Research Center, Hampton, VA USA
❷ **Water Tunnel Flow Visualization Study Through Poststall of 12 Novel Planform Shapes**
❸ Gatlin, Gregory M., NASA Langley Research Center, USA Neuhart, Dan H., Lockheed Engineering and Sciences Co., USA;
❹ Mar. 1996; 130p; In English
❺ Contract(s)/Grant(s): RTOP 505-68-70-04
❻ Report No(s): NASA-TM-4663; NAS 1.15:4663; L-17418; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
❼ To determine the flow field characteristics of 12 planform geometries, a flow visualization investigation was conducted in the Langley 16- by 24-Inch Water Tunnel. Concepts studied included flat plate representations of diamond wings, twin bodies, double wings, cutout wing configurations, and serrated forebodies. The off-surface flow patterns were identified by injecting colored dyes from the model surface into the free-stream flow. These dyes generally were injected so that the localized vortical flow patterns were visualized. Photographs were obtained for angles of attack ranging from 10' to 50', and all investigations were conducted at a test section speed of 0.25 ft per sec. Results from the investigation indicate that the formation of strong vortices on highly swept forebodies can improve poststall lift characteristics; however, the asymmetric bursting of these vortices could produce substantial control problems. A wing cutout was found to significantly alter the position of the forebody vortex on the wing by shifting the vortex inboard. Serrated forebodies were found to effectively generate multiple vortices over the configuration. Vortices from 65' swept forebody serrations tended to roll together, while vortices from 40' swept serrations were more effective in generating additional lift caused by their more independent nature.
❽ Author
❾ *Water Tunnel Tests; Flow Visualization; Flow Distribution; Free Flow; Planforms; Wing Profiles; Aerodynamic Configurations*

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8. Abstract Author
9. Subject Terms

01
AERONAUTICS

19990019378 NASA Langley Research Center, Hampton,VA USA
Aeronautical Engineering: A Continuing Bibliography with Indexes, Supplment 394
Feb. 19, 1999; 34p; In English
Report No.(s): NASA/SP-1999-7037/SUPPL394; NAS 1.21:7037/SUPPL394; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This supplemental issue of Aeronautical Engineering, A Continuing Bibliography with Indexes (NASA/SP-1999-7037) lists reports, articles, and other documents recently announced in the NASA STI Database. The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles. Each entry in the publication consists of a standard bibliographic citation accompanied, in most cases, by an abstract. The NASA CASI price code table, addresses of organizations, and document availability information are included before the abstract section. Two indexes-subject and author are included after the abstract section.
CASI
Aerodynamics; Aeronautical Engineering; Bibliographies; Indexes (Documentation)

19990019602 Logistics Management Inst., McLean, VA USA
The Aviation System Analysis Capability Air Carrier Cost-Benefit Model *Final Report*
Gaier, Eric M., Logistics Management Inst., USA; Edlich, Alexander, Logistics Management Inst., USA; Santmire, Tara S., Logistics Management Inst., USA; Wingrove, Earl R.., III, Logistics Management Inst., USA; Jan. 1999; 55p; In English
Contract(s)/Grant(s): NAS2-14361; RTOP 538-16-11-01
Report No.(s): NASA/CR-1999-208983; NS804S1; NAS 1.26:208983; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

To meet its objective of assisting the U.S. aviation industry with the technological challenges of the future, NASA must identify research areas that have the greatest potential for improving the operation of the air transportation system. Therefore, NASA is developing the ability to evaluate the potential impact of various advanced technologies. by thoroughly understanding the economic impact of advanced aviation technologies and by evaluating how the new technologies will be used in the integrated aviation system, NASA aims to balance its aeronautical research program and help speed the introduction of high-leverage technologies. to meet these objectives, NASA is building the Aviation System Analysis Capability (ASAC). NASA envisions ASAC primarily as a process for understanding and evaluating the impact of advanced aviation technologies on the U.S. economy. ASAC consists of a diverse collection of models and databases used by analysts and other individuals from the public and private sectors brought together to work on issues of common interest to organizations in the aviation community. ASAC also will be a resource available to the aviation community to analyze; inform; and assist scientists, engineers, analysts, and program managers in their daily work. The ASAC differs from previous NASA modeling efforts in that the economic behavior of buyers and sellers in the air transportation and aviation industries is central to its conception. Commercial air carriers, in particular, are an important stakeholder in this community. Therefore, to fully evaluate the implications of advanced aviation technologies, ASAC requires a flexible financial analysis tool that credibly links the technology of flight with the financial performance of commercial air carriers. by linking technical and financial information, NASA ensures that its technology programs will continue to benefit the user community. In addition, the analysis tool must be capable of being incorporated into the wide-ranging suite of economic and technical models that comprise ASAC. This report describes an Air Carrier Cost-Benefit Model (CBM) that meets these requirements.

The ASAC CBM is distinguished from many of the aviation cost-benefit models by its exclusive focus on commercial air carriers. The model considers such benefit categories as time and fuel savings, utilization opportunities, reliability and capacity enhancements, and safety and security improvements. The model distinguishes between benefits that are predictable and those that occur randomly. by making such a distinction, the model captures the ability of air carriers to reoptimize scheduling and crew assignments for predictable benefits. In addition, the model incorporates a life-cycle cost module for new technology, which applies the costs of nonrecurring acquisitions, recurring maintenance and operation, and training to each aircraft equipment type independently.
Author
Commercial Aircraft; Cost Analysis; Models; Air Transportation; Operating Costs; Systems Analysis

19990019603 Logistics Management Inst., McLean, VA USA
Aviation System Analysis Capability Air Carrier Investment Model-Cargo ***Final Report***
Johnson, Jesse, Logistics Management Inst., USA; Santmire, Tara, Logistics Management Inst., USA; Jan. 1999; 41p; In English; Original contains color illustration
Contract(s)/Grant(s): NAS2-14361; RTOP 538-16-11-01
Report No.(s): NASA/CR-1999-208984; NS803S1; NAS 1.26:208984; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The purpose of the Aviation System Analysis Capability (ASAC) Air Cargo Investment Model-Cargo (ACIMC), is to examine the economic effects of technology investment on the air cargo market, particularly the market for new cargo aircraft. to do so, we have built an econometrically based model designed to operate like the ACIM. Two main drivers account for virtually all of the demand: the growth rate of the Gross Domestic Product (GDP) and changes in the fare yield (which is a proxy of the price charged or fare). These differences arise from a combination of the nature of air cargo demand and the peculiarities of the air cargo market. The net effect of these two factors are that sales of new cargo aircraft are much less sensitive to either increases in GDP or changes in the costs of labor, capital, fuel, materials, and energy associated with the production of new cargo aircraft than the sales of new passenger aircraft. This in conjunction with the relatively small size of the cargo aircraft market means technology improvements to the cargo aircraft will do relatively very little to spur increased sales of new cargo aircraft.
Author
Air Cargo; Air Transportation; Systems Analysis; Cargo Aircraft

19990019831 NASA Ames Research Center, Moffett Field, CA USA
HPCCP/CAS Workshop Proceedings 1998
Schulbach, Catherine, NASA Ames Research Center, USA; Mata, Ellen, Editor, Raytheon Co., USA; Schulbach, Catherine, Editor, NASA Ames Research Center, USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999; 275p; In English; Sponsored by NASA Ames Research Center, USA; See also 19990019832 through 19990019878
Contract(s)/Grant(s): RTOP 509-10-61
Report No.(s): NASA/CP-1999-208757; A-990762; NAS 1.55:208757; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche

This publication is a collection of extended abstracts of presentations given at the HPCCP/CAS (High Performance Computing and Communications Program/Computational Aerosciences Project) Workshop held on August 24-26, 1998, at NASA Ames Research Center, Moffett Field, California. The objective of the Workshop was to bring together the aerospace high performance computing community, consisting of airframe and propulsion companies, independent software vendors, university researchers, and government scientists and engineers. The Workshop was sponsored by the HPCCP Office at NASA Ames Research Center. The Workshop consisted of over 40 presentations, including an overview of NASA's High Performance Computing and Communications Program and the Computational Aerosciences Project; ten sessions of papers representative of the high performance computing research conducted within the Program by the aerospace industry, academia, NASA, and other government laboratories; two panel sessions; and a special presentation by Mr. James Bailey.
Author
Computer Programming; Computer Systems Design; Computer Systems Performance; Algorithms; Computer Programs; Parallel Computers; Multidisciplinary Research; Computer Aided Design; Mathematical Programming; Conferences; Aerospace Systems

02
AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

19990019285 Israel Inst. of Tech., Dept. of Aeronautical Engineering, Haifa, Israel
Numerical Calculation of Nonlinear Aerodynamics of Wing-Body Configurations
Rusak, Z., Israel Inst. of Tech., Israel; Wasserstrom, E., Israel Inst. of Tech., Israel; Seginer, A., Israel Inst. of Tech., Israel; AIAA Journal; Jul. 1983; Volume 21, No. 7, pp. 929-936; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

A numerical method for the calculation of the nonlinear aerodynamic characteristics of wing-body configurations in steady low subsonic flow has been developed. The method is based on a combination of the linear source-panel method for the body and the nonlinear vortex-lattice method for the lifting surfaces and their separated wakes. Special emphasis is given to the understanding of the behavior and the computational accuracy of the numerical method. In order to demonstrate the capabilities of the present method, total and distributed loads are computed and compared with available experimental results. The computed examples cover simple configurations as well as more complicated geometries with greater relevance to modem missiles and aircraft. Details of the calculations clarify the significant nonlinear contribution of the body to the aerodynamic properties of the configuration. Good agreement was found between the computations and the experiments.
Author
Body-Wing Configurations; Steady Flow; Subsonic Flow; Aerodynamic Characteristics; Vortex Lattice Method; Panel Method (Fluid Dynamics); Nonlinearity

19990019318 Manchester Univ., School of Engineering, UK
Improved Flight Flutter Testing Excitation Techniques ***Final Report***
Desforges, M. J., Manchester Univ., UK; Cooper, J. E., Manchester Univ., UK; Sep. 28, 1998; 46p; In English
Contract(s)/Grant(s): F61775-98-WE012
Report No.(s): AD-A357902; DCRG/98/EOARD/2; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report results from a contract tasking School of Engineering University of Manchester as follows: The contractor will investigate improvements in excitations signals used in aircraft flutter flight test data collection. It describes the work done during the period 1 April - 30 September 1998 for the EOARD contract F61775-98-WEO12 on Improved Flight Flutter Testing Excitation Techniques. Strategies.
DTIC
Flight Tests; Flutter; Data Acquisition

19990019363 Institute for Computer Applications in Science and Engineering, Hampton, VA USA
Navier-Stokes Analysis of the Flowfield Characteristics of an Ice Contaminated Aircraft Wing
Chung, J., Institute for Computer Applications in Science and Engineering, USA; Choo, Y., NASA Lewis Research Center, USA; Reehorst, A., NASA Lewis Research Center, USA; Potapczuk, M., NASA Lewis Research Center, USA; Slater, J., NASA Lewis Research Center, USA; January 1999; 22p; In English; 37th; Aerospace Sciences, 11-14 Jan. 1999, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): RTOP 548-20-23
Report No.(s): NASA/TM-1999-208897; NAS 1.15:208897; AIAA Paper 99-0375; ICOMP-99-03; E-11496; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An analytical study was performed as part of the NASA Lewis support of a National Transportation Safety Board (NTSB) aircraft accident investigation. The study was focused on the performance degradation associated with ice contamination on the wing of a commercial turbo-prop-powered aircraft. Based upon the results of an earlier numerical study conducted by the authors, a prominent ridged-ice formation on the subject aircraft wing was selected for detailed flow analysis using 2-dimensional (2-D), as well as, 3-dimensional (3-D) Navier-Stokes computations. This configuration was selected because it caused the largest lift decrease and drag increase among all the ice shapes investigated in the earlier study. A grid sensitivity test was performed to find out the influence of grid spacing on the lift, drag, and associated angle-of-attack for the maximum lift (C(sub lmax)). This study showed that grid resolution is important and a sensitivity analysis is an essential element of the process in order to assure that the final solution is independent of the grid. The 2-D results suggested that a severe stability and control difficulty could have occurred at a slightly higher angle-of-attack (AOA) than the one recorded by the Flight Data Recorder (FDR). This stability and control problem was thought to have resulted from a decreased differential lift on the wings with respect to the normal loading for the configuration. The analysis also indicated that this stability and control problem could have occurred whether or not natural ice shedding took place. Numerical results using an assumed 3-D ice shape showed an increase of the angle at which this phenomena

occurred of about 4 degrees. As it occurred with the 2-D case, the trailing edge separation was observed but started only when the AOA was very close to the angle at which the maximum lift occurred.
Author
Ice Formation; Wings; Navier-Stokes Equation; Contamination; Aircraft Icing; Computational Fluid Dynamics; Aerodynamic Characteristics

19990019475 NASA Lewis Research Center, Cleveland, OH USA
A Review of NASA Lewis' Development Plans for Computational Simulation of Aircraft Icing
Potapczuk, Mark G., NASA Lewis Research Center, USA; January 1999; 18p; In English; 37th; Aerospace Sciences, 11-14 Jan. 1999, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): RTOP 548-21-23
Report No.(s): NASA/TM-1999-208904; NAS 1.15:208904; E-11517; AIAA Paper 99-0243; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The use of computational methods in the simulation of flight in icing, conditions is an ongoing, research effort by the Icing Branch at the NASA Lewis Research Center. The development of accurate, robust, well-documented, well-maintained computational tools is a major function of the research activities of the Icing, Branch, in collaboration with its grantees and contractors. The goal of the Icing, Branch's efforts is to provide simulation methods that can be used to aid in design, testing, certification, and qualification efforts related to flight in icing conditions. This paper will detail the current research and plans for future efforts in the development of computational tools for simulation of ice accretion, ice protection systems, the effects of ice on aircraft performance characteristics, and the behavior of aircraft systems subjected to icing conditions.
Author
Aircraft Icing; Aircraft Performance; Deicing; Flight Conditions; Ice Formation; Ice Prevention

19990019704 Chicago State Univ., Dept. of Mathematics and Computer Science, Chicago, IL USA
Assessment of Turbulent Models for Single-Element Airfoil at High-Lift
Getachew, Dawit, Chicago State Univ., USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 62; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

The present study consists of: flow calculations around an AEROSPATIALE A-airfoil at high angles of attacks, and assessing different turbulence models by comparing numerically predicted turbulent flow characteristics over the airfoil against reference experimental values. The turbulence models investigated include: (i) the Spalart-Allmaras (SA) one equation mode (ii) the Mentr's k-Omega Shear Stress Transport (MSST) model and (ill) the k - 6 version of the Explicit Algebraic model of Gateski and Spezial with variable (p). To attain this goal, a series of computations, using CFL3Dv5 code of NASA Langley Research Center, have been performed for a M = 0.15, angles of attacks at 3.4, 10.1, 14.1 and 17.1 and Re = 3.13 x 10, as well as a low Reynolds number test case Re = 2 x 10(exp 6) and at incidence a = 13.3. For all the calculations performed in this investigation, the location of transition points on the suction and pressure sides are fixed at 12% and 30% of the chord, respectively, and we used the mandatory structured C-mesh consisting of 512 cells in the wrap-around directions and 128 cells in wall-normal direction. The wake was covered by 64 cells and 384 cells were located on the airfoil surface. The results of this investigation show that the performance of the two linear eddy viscosity models, namely SA and MSST, is the same for most of the test cases considered. Furthermore, for the low Reynolds number test case, these two models did perform better than the nonlinear eddy viscosity model (EASM), whereas for the high Reynolds number test case the EASM perform well. Since the grid independence study, to generate the fine mesh used in the present investigation, was performed using linear eddy viscosity models, it is difficult to draw, using the aforementioned results, any conclusion about the overall performance of EASM as compared to the other two linear eddy viscosity models.
Author
Turbulence Models; Turbulent Flow; Airfoils; Eddy Viscosity; Flow Characteristics; Shear Stress; Stress Analysis

19990019719 Old Dominion Univ., Dept. of Engineering Technology, Norfolk, VA USA
Hyper-X Research Vehicle Stage Separation: Mach 7 Time Accurate Viscous Computations
Mohieldin, Taj O., Old Dominion Univ., USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 79; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

With the present interest in aerospace planes, considerable effort is being devoted to the development of propulsion systems that would power these vehicles. Among the proposed engine systems, scramjet engine (supersonic combustion ramjet) has been

expected to be applied as the propulsion system. NASA's hypersonic technology program Hyper-X, has been initiated to elevate scramjet powered hypersonic technology readiness (TRL's) from the wind tunnel to the real flight environment, the last stage preceding prototype development. The program is now concentrating on Mach 7 vehicle development, verification and validation and flight test risk reduction. The desired test condition for the hyper-X in free flight is a dynamic pressure of 1000 pounds per square foot. The research vehicle will be boosted to approximately 95,000 feet for Mach 7. Following drop from the B-52 and boost to the predetermined stage separation point, the hyper-X research vehicle will be ejected from the booster-stack and start the programmed flight test. The stage separation will resume with the ignition of the explodable rivets fastening the vehicle to the arm. Then the arm will swing down about the hinge connected to the Hyper-X Launch vehicle leaving the research vehicle free and air-borne at the desired flight speed. CFD computations and experimental data with the drop-jaw adaptor at several rotation angles predicted significant interference on the hyper-X research vehicle during stage separation. Several dynamic simulation of hyper-X stage separation have been presented using time accurate inviscid computations. However, an adequate prediction of this unsteady hypersonic flowfield should include viscous effects. The focus of this study is to perform dynamic simulations of hyper-X stage separation to assess viscous effects on the transient forces and moments and to compare with the inviscid results. The unstructured grid solver, Rampant, is used to perform the steady state and time accurate analysis. Results for MACH 7 steady state and time accurate inviscid and viscous computations with fixed 0.5 inch cavity openings are presented in this study.
Author
Hypersonic Speed; Hypersonics; Research Aircraft; Aerospace Planes; Launch Vehicles; Mach Number; Propulsion System Configurations; Propulsion System Performance

19990019869 NASA Ames Research Center, Moffett Field, CA USA
Aerodynamic Shape Optimization Using A Combined Distributed/Shared Memory Paradigm
Cheung, Samson, MRJ Technology Solutions, USA; Holst, Terry, NASA Ames Research Center, USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 207-212; In English; See also 19990019831; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

Current parallel computational approaches involve distributed and shared memory paradigms. In the distributed memory paradigm, each processor has its own independent memory. Message passing typically uses a function library such as MPI or PVM. In the shared memory paradigm, such as that used on the SGI Origin 2000 machine, compiler directives are used to instruct the compiler to schedule multiple threads to perform calculations. In this paradigm, it must be assured that processors (threads) do not simultaneously access regions of memory in such away that errors would occur. This paper utilizes the latest version of the SGI MPI function library to combine the two parallelization paradigms to perform aerodynamic shape optimization of a generic wing/body.
Author
Distributed Memory; Interprocessor Communication; Optimization; Newton Methods; Parallel Processing (Computers); Aircraft Design

19990019870 National Academy of Sciences - National Research Council, Hampton, VA USA
High-Fidelity Analysis and Aerodynamic Optimization of a Supersonic Transport
Giunta, Anthony A., National Academy of Sciences - National Research Council, USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 213-218; In English; See also 19990019831; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

A suite of modular government/commercial off-the-shelf (G/COTS) software packages has been created to perform high-fidelity aeroelastic analysis and aerodynamic optimization of aircraft configurations. While the current status of the software permits multidisciplinary analysis and single-disciplinary optimization, the goal of this research is to develop a high-fidelity multidisciplinary optimization (MDO) capability in which various MDO methods will be examined on realistic aircraft design problems. The existing MPI-based parallel computing capability in some elements of the G/COTS software is a key component in realizing the goal of high-fidelity MDO. In particular, the parallel computing capabilities allow the efficient calculation of sensitivity derivatives needed to perform gradient-based optimization. to demonstrate the utility of this modular G/COTS software approach, an aeroelastic analysis and aerodynamic optimization of a high-speed civil transport (HSCT) are examined.
Author
Aerodynamic Configurations; Applications Programs (Computers); Multidisciplinary Design Optimization; Aeroelasticity; Parallel Processing (Computers); Design Analysis

19990019871 NASA Langley Research Center, Hampton, VA USA

Parallel Computation of Sensitivity Derivatives with Application to Aerodynamic Optimization of a Wing

Biedron, Robert T., NASA Langley Research Center, USA; Samareh, Jamshid A., NASA Langley Research Center, USA; Green, Lawrence T., NASA Langley Research Center, USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 219-224; In English; See also 19990019831; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

This paper focuses on the parallel computation of aerodynamic derivatives via automatic differentiation of the Euler/Navier-Stokes solver CFL3D. The comparison with derivatives obtained by finite differences is presented and the scaling of the time required to obtain the derivatives relative to the number of processors employed for the computation is shown. Finally, the derivative computations are coupled with an optimizer and surface/volume grid deformation tools to perform an optimization to reduce the drag of a three-dimensional wing.

Author

Parallel Processing (Computers); Applications Programs (Computers); Computation; Optimization; Wing Profiles; Differentiation; Parameterization

19990019872 NASA Langley Research Center, Hampton, VA USA

Demonstration of Automatically-Generated Adjoint Code for Use in Aerodynamic Shape Optimization

Green, Lawrence, NASA Langley Research Center, USA; Carle, Alan, Rice Univ., USA; Fagan, Mike, Rice Univ., USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 225-229; In English; See also 19990019831; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

Gradient-based optimization requires accurate derivatives of the objective function and constraints. These gradients may have previously been obtained by manual differentiation of analysis codes, symbolic manipulators, finite-difference approximations, or existing automatic differentiation (AD) tools such as ADIFOR (Automatic Differentiation in FORTRAN). Each of these methods has certain deficiencies, particularly when applied to complex, coupled analyses with many design variables. Recently, a new AD tool called ADJIFOR (Automatic Adjoint Generation in FORTRAN), based upon ADIFOR, was developed and demonstrated. Whereas ADIFOR implements forward-mode (direct) differentiation throughout an analysis program to obtain exact derivatives via the chain rule of calculus, ADJIFOR implements the reverse-mode counterpart of the chain rule to obtain exact adjoint form derivatives from FORTRAN code. Automatically-generated adjoint versions of the widely-used CFL3D computational fluid dynamics (CFD) code and an algebraic wing grid generation code were obtained with just a few hours processing time using the ADJIFOR tool. The codes were verified for accuracy and were shown to compute the exact gradient of the wing lift-to-drag ratio, with respect to any number of shape parameters, in about the time required for 7 to 20 function evaluations. The codes have now been executed on various computers with typical memory and disk space for problems with up to 129 x 65 x 33 grid points, and for hundreds to thousands of independent variables. These adjoint codes are now used in a gradient-based aerodynamic shape optimization problem for a swept, tapered wing. For each design iteration, the optimization package constructs an approximate, linear optimization problem, based upon the current objective function, constraints, and gradient values. The optimizer subroutines are called within a design loop employing the approximate linear problem until an optimum shape is found, the design loop limit is reached, or no further design improvement is possible due to active design variable bounds and/or constraints. The resulting shape parameters are then used by the grid generation code to define a new wing surface and computational grid. The lift-to-drag ratio and its gradient are computed for the new design by the automatically-generated adjoint codes. Several optimization iterations may be required to find an optimum wing shape. Results from two sample cases will be discussed. The reader should note that this work primarily represents a demonstration of use of automatically- generated adjoint code within an aerodynamic shape optimization. As such, little significance is placed upon the actual optimization results, relative to the method for obtaining the results.

Derived from text

Applications Programs (Computers); Aerodynamic Configurations; Shape Functions; Optimization; Grid Generation (Mathematics); Differential Calculus; Aircraft Design; Computer Techniques

19990019873 Boeing Co., Long Beach, CA USA

Applications of Parallel Processing in Aerodynamic Analysis and Design

Sundaram, P., Boeing Co., USA; Hager, James O., Boeing Co., USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 231-237; In English; See also 19990019831; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The continuously growing size and computational complexity of CFD-based aerodynamic analysis problems demand larger and larger computational resources. In addition, quick turn-around time for design and synthesis are necessary to make high fidelity, CFD-based techniques practical. Typical full-configuration, Navier-Stokes analysis grids tend to have more than 10 million points, and the solutions to these problems require very large amounts of CPU time and memory. Also, CFD-based nonlinear shape

optimization of full aircraft configurations is required within a few weeks to meet the cost and schedule challenges of today's aerospace customer. Traditional sequential computers cannot deliver these large computing resources, and no new large sequential vector supercomputers are under development. Thus, parallel processing has emerged as the most efficient and cost-effective method to achieve the large computational resources required for these advanced CFD applications. This paper presents the recent progress made in the application of the CFL3Dhp parallel code for configuration analyses and aerodynamic shape optimization at Boeing-Phantom Works (BPW). CFL3Dhp is the coarse-grain parallel version of the CFL3D Euler/Navier-Stokes solver developed at NASA LARC. CFL3Dhp utilizes the MPI message-passing library to exchange information with other task processors as well as with the host. CFL3Dhp runs on most available parallel platforms and distributed environments. Several utilities have been developed at BPW to provide a user-friendly parallel environment.
Author
Parallel Processing (Computers); Aerodynamic Configurations; Aerodynamics; Aircraft Design; Applications Programs (Computers); Optimization; Design Analysis

19990020957 NASA Langley Research Center, Hampton,VA USA
Effects of Convoluted Divergent Flap Contouring on the Performance of a Fixed-Geometry Nonaxisymmetric Exhaust Nozzle
Asbury, Scott C., NASA Langley Research Center, USA; Hunter, Craig A., NASA Langley Research Center, USA; Feb. 1999; 75p; In English
Contract(s)/Grant(s): RTOP 538-14-12-01
Report No.(s): NASA/TP-1999-209093; L-17696; NAS 1.60:209093; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

An investigation was conducted in the model preparation area of the Langley 16-Foot Transonic Tunnel to determine the effects of convoluted divergent-flap contouring on the internal performance of a fixed-geometry, nonaxisymmetric, convergent-divergent exhaust nozzle. Testing was conducted at static conditions using a sub-scale nozzle model with one baseline and four convoluted configurations. All tests were conducted with no external flow at nozzle pressure ratios from 1.25 to approximately 9.50. Results indicate that baseline nozzle performance was dominated by unstable, shock-induced, boundary-layer separation at overexpanded conditions. Convoluted configurations were found to significantly reduce, and in some cases totally alleviate separation at overexpanded conditions. This result was attributed to the ability of convoluted contouring to energize and improve the condition of the nozzle boundary layer. Separation alleviation offers potential for installed nozzle aeropropulsive (thrust-minus-drag) performance benefits by reducing drag at forward flight speeds, even though this may reduce nozzle thrust ratio as much as 6.4% at off-design conditions. At on-design conditions, nozzle thrust ratio for the convoluted configurations ranged from 1% to 2.9% below the baseline configuration; this was a result of increased skin friction and oblique shock losses inside the nozzle.
Author
Convergent-Divergent Nozzles; Boundary Layer Separation; Wind Tunnel Nozzles; Wind Tunnel Tests; Nozzle Flow; Oblique Shock Waves; Flow Visualization

03
AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

19990019320 Joint Chiefs of Staff, Washington, DC USA
Joint Tactics, Techniques, and Procedures for Shipboard Helicopter Operations
Dec. 10, 1997; 214p; In English
Report No.(s): AD-A358011; JOINT-PUB-3-04.1; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

This publication provides operating and aviation ordnance procedures required to plan and conduct shipboard helicopter operations and places emphasis on single-ship, single- helicopter independent operations. The publication is written to reflect: routine operations for the deployment of joint force helicopters on board US Navy (USN) and US Coast Guard (USCG) ships. This is generally the result of careful presail planning, but does not preclude crisis response, surge requirements, or warfighting execution. This publication describes shipboard helicopter operational procedures for both embarked and transient aircraft and aviation detachments. Some of the terminology, regulations, and routine I encountered aboard ship reflect naval traditions and contribute to efficient and safe operations.
DTIC
Helicopters; Military Operations; Navy; Tactics; Ships; Procedures

19990019485 NASA Lewis Research Center, Cleveland, OH USA
NASA/FAA Tailplane Icing Program Overview
Ratvasky, Thomas P., NASA Lewis Research Center, USA; VanZante, Judith Foss, DYNACS Engineering Co., Inc., USA; Riley, James T., Federal Aviation Administration, USA; January 1999; 16p; In English; 37th; Aerospace Sciences, 11-14 Jan. 1999, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): NAS3-98008; RTOP 548-20-23
Report No.(s): NASA/TM-1999-208901; NAS 1.15:208901; E-11502; AIAA Paper 99-0370; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The effects of tailplane icing were investigated in a four-year NASA/FAA Tailplane Icing, Program (TIP). This research program was developed to improve the understanding, of iced tailplane aeroperformance and aircraft aerodynamics, and to develop design and training aides to help reduce the number of incidents and accidents caused by tailplane icing. to do this, the TIP was constructed with elements that included icing, wind tunnel testing, dry-air aerodynamic wind tunnel testing, flight tests, and analytical code development. This paper provides an overview of the entire program demonstrating the interconnectivity of the program elements and reports on current accomplishments.
Author
Aircraft Icing; Horizontal Tail Surfaces; Flight Tests

19990019696 Pittsburgh State Univ., Dept. of Engineering Technology, KS USA
Engineering Study for Reactivation of a Six Degrees of Freedom Platform for Aeronautical Safety Investigations
Buchanan, Randy K., Pittsburgh State Univ., USA; Lookadoo, James A., Pittsburgh State Univ., USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 52; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

The Systems Integration Branch of the Flight Electronics Technology Division at NASA/Langley Research Center possesses a hydraulically operated six degrees of freedom (Stewart) platform that had previously supported microgravity robotics investigations. New directions for NASA's Aeronautical enterprise are driving new initiatives throughout Langley. Future branch operations may incorporate a variety of aeronautical safety investigations. This expectation generated the need to reengineer the platform as a test bed for new experiments. Suitability issues extend beyond the inherent physical and performance parameters of the platform. These operational characteristics were found to be adequate for most of the new testing regimens envisioned. The problem investigated also had constraints in economics and maintainability characteristics. In the leaner budget environment, the platform must not prove too costly to operate or to upgrade. Finally, a wider customer base of users beyond the Systems Integration Branch is anticipated. The facility must incorporate a researcher-friendly interface for these potential new users. Meeting all of the constraints for the problem indicated a solution saving 0 of the current actuator and sensor elements on the platform. Additionally, most of the existing control hardware and control software elements were identified as replaceable with newer and more robust solutions. Meeting the economic guidelines suggested a Pentium grade of PC with appropriate 1/0 enhancements as the optimal controls environment for a refurbished platform. This machine would host any necessary kinematics calculations, control algorithms, experiment stimulus generation and resident safety monitoring software elements. Additionally, network capability would allow the platform control PC to support either local or remote computing facilities operating as research interfaces. These ancillary machines would also host the instrumentation systems supporting the experiments mounted on the platform. The final recommendation actually contains a set of potential but workable solutions for implementation. In this fashion, a wider set of experiments and customers may be accommodated.
Author
Degrees of Freedom; Robotics; Kinematics; Computer Programs; Systems Integration; Computers; Economics

19990020984 Federal Aviation Administration, Washington, DC USA
Notices to Airmen Domestic/International, December 3, 1998
1998; 192p; In English
Report No.(s): PB99-118978; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

Table of Contents: Airway Notams; Airports, Facilities, and Procedural Notams; General FDC Notams; Part 95 Revisions to Minimum En Route IFR Altitudes and Changeover Points; International Notices to Airmen; and Graphic Notices.
NTIS
National Airspace System; Air Navigation

04
AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

19990019289 NASA Ames Research Center, Moffett Field, CA USA
Civil Helicopter Flight Operations using Differential GPS
Edwards, Frederick G., NASA Ames Research Center, USA; Loomis, Peter V. W., TAU Corp., USA; Navigation: Journal of the Institute of Navigation; 1985; Volume 32, No. 3, pp. 233-253; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

NASA Ames Research Center conducted a nonreal-time, Differential Global Positioning System (DGPS) flight-test experiment using two coarse-acquisition (C/A) code GPS receivers. The data were recorded concurrently at a fixed site and on board the NASA SH-3G test helicopter. The aircraft conducted several simulated mission operations, including terminal approach, while being tracked by radar and laser systems. After the flights, data recorded by the two GPS receivers and the trackers were analyzed to determine whether differential corrections could improve the navigation performance of the airborne GPS receiver. An airborne navigation error history was obtained by subtracting the reference "true' trajectory (derived from the tracking data) from the airborne GPS navigation solution. At the same time, differential GPS corrections were obtained by subtracting the ground-station GPS navigation solution from the true (surveyed) location of the ground receiver. Filtering was used to separate receiver-unique errors in the GPS data from the locally common (spatially correlated) GPS errors. The result's show high correlation between airborne navigation errors and the differential corrections. The airborne navigation solution is shown to be much improved after the addition of the differential corrections. Efforts are continuing to develop a real-time differential data link between the ground station and the aircraft.
Author
Global Positioning System; Helicopters; Flight Operations; Flight Tests; Real Time Operation; Air Navigation

19990019756 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Interferometric GPS/Micro-Mechanical Gyro Attitude Determination System: A Study Into the Integration Issues
Giustino, Antonio; Oct. 14, 1998; 126p; In English
Report No.(s): AD-A356190; AFIT-98-090; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The near future will see a proliferation of small low cost communication and science satellites with modest (0.1-0.5 deg) pointing requirements which will use attitude determination Systems (ADS's) of low power, weight, size, and cost. This project proposes to synthesize two in-house navigation systems as an alternative for the traditional LEO/MEO spacecraft ADS suite. This system consists of the Draper Micro-Mechanical (MM) gyroscopes aided by an interferometric GPS (IGPS) receiver. The two systems are integrated in a highly-coupled design through an extended Kalman filter (EKF).
DTIC
Satellite Attitude Control; Communication Satellites; Global Positioning System; Interferometry; Navigation; Gyroscopes

05
AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

19990019135 NASA Marshall Space Flight Center, Huntsville, AL USA
X-34 Program Status
London, John R., III, NASA Marshall Space Flight Center, USA; Creech, Stephen D., NASA Marshall Space Flight Center, USA; 1998; 7p; In English, 28-30 Oct. 1998, Huntsville, AL, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): IAF-98-V-4-04; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The National Aeronautics and Space Administration (NASA) initiated the current X-34 program in 1996 as part of the U.S. space agency's effort to dramatically reduce the cost of access to space. The X-34 is the first in a series of "Pathfinder" vehicles designed to conduct flight testing of key launch vehicle technologies at low cost. The X-34 program has moved rapidly from the drawing board to hardware build-up, with the first flight scheduled for 1999. The development of the X-34 has been accomplished by a unique blend of industry and government organizations and personnel working closely together. The program will provide rocket powered winged vehicles that can fly sub-orbital missions in support of advanced reusable launch vehicle technology

development. In addition, the X-34 vehicles will represent a hypersonic test bed for advanced experiments in the aeronautical sciences.
Author
X-34 Reusable Launch Vehicle; NASA Programs; Flight Tests; Cost Reduction

19990019287 NASA Ames Research Center, Moffett Field, CA USA
Frequency-Domain Identification of XV-15 Tilt-Rotor Aircraft Dynamics in Hovering Flight
Tischler, Mark B., Army Research and Technology Labs., USA; Leung, Joseph G. M., NASA Ames Research Center, USA; Dugan, Daniel C., NASA Ames Research Center, USA; Journal of the American Helicopter Society; Apr. 1985, pp. 38-48; In English; 2nd; Flight Testing, Nov. 1983, Las Vegas, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Frequency-domain methods are used to identify the open-loop dynamics of the XV-15 tilt-rotor aircraft from flight tests. Piloting and data analysis techniques are presented to determine frequency response plots and equivalent transfer function models. The open-loop pitch and roll dynamics for the hover flight condition exhibit unstable low-frequency oscillations, whereas the dynamics in the remaining degrees of freedom are lightly damped and generally decoupled. Comparisons of XV-15 flight-test and simulator data are more favorable for high-frequency inputs (omega greater than 1.0 rad/sec) than low-frequency inputs. Time-domain comparisons of the extracted transfer functions with step response flight data are very favorable, even for large amplitude motions. The results presented in this paper demonstrate the utility of the frequency-domain techniques for dynamics identification and simulator fidelity studies.
Author
XV-15 Aircraft; Frequency Response; Hovering; Tilt Rotor Aircraft; Rotor Dynamics; Flight Tests

19990019457 California Univ., Dept. of Mechanical and Aerospace Engineering, Los Angeles, CA USA
A Fundamental Study of Active Vibration Control in Rotorcraft Using the ACSR Approach ***Final Report, 15 Oct. 1992 - 14 Apr. 1997***
Friedmann, Peretz P.; Dec. 20, 1997; 12p; In English
Contract(s)/Grant(s): DAAH04-93-G-0004
Report No.(s): AD-A358026; ARO-29641.1-EG; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This is the final report describing the objectives and accomplishments of the research conducted under the above referenced grant. The general purpose of this grant has been to study a novel approach to active vibration control in helicopter fuselages known as the Active Control of Structural Response (ACSR) approach. In this approach vibrations in the helicopter fuselage are reduced by introducing harmonically varying forces by actuators located between the rotor and the fuselage such that the sum of the response of the airframe, due to rotor loads and external excitation, is reduced to a minimum. The primary objectives of this research were: (1) development of a coupled rotor/flexible fuselage model capable of simulating the vibrations in the fuselage and their control using the ACSR system, (2) modeling of the closed loop vibration reduction using two different control algorithms, a simple algorithm denoted the BACSR-algorithm, and a more refined algorithm based upon the internal model principle, denoted as the IMP-algorithm, and (3) conduct trend studies, to demonstrate vibration reduction throughout the flight envelope of the helicopter. All the objectives stated were achieved in the course of the research. Reduction of vibration levels below 0.04g was demonstrated throughout the flight envelope, with relatively modest control effort, and low control power requirements. This research also provided a fundamental understanding of the approach that was not available from the experimental and empirical studies conducted before.
DTIC
Vibration Damping; Fuselages; Active Control; Feedback Control; Helicopters; Rotors; Structural Vibration

19990019643 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
A Study of Fretting Fatigue in Aircraft Components
Birch, Paul R.; Oct. 14, 1998; 153p; In English
Report No.(s): AD-A356297; AFIT-98-088; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

This thesis presents theoretical computational, and experimental approaches to the problem of fretting fatigue in materials systems relevant to aircraft components. The basic contact mechanics for fretting fatigue in a sphere-plane contact geometry are reviewed. Various elastic criteria for predicting fretting failure are discussed; selected fretting maps created from one of these the modified Crossland criterion are presented. Fail/no-fail predictions based on these maps have verified trends observed in experimental work performed on Al 7075-T6 specimens. A three-dimensional finite-element model of sphere-plane fretting contact is reviewed. This model has been used to model elastic and elastoplastic fretting contact. The evolution of tangential loads coincident

with plastic flow has been simulated, as well as the accumulation of equivalent plastic strains for these fretting conditions. This information may be used to predict the life of components subject to fretting contact high cycle fatigue (HCF) via a Coffin-Manson type relation. Design and construction of an apparatus for performing quantitative fretting experiments are described, and results of early tests performed on 7075-T6 aluminum alloys are presented. These experiments validate the proper operation of the experimental apparatus. Finally, basic principles of fracture mechanics and the limitations of applying traditional linear elastic fracture mechanics (LEFM) to fretting fatigue are discussed. The new crack analogue concept of Giannakopoulos et al. is reviewed as a means of uniting LEFM and fretting contact mechanics to achieve a life prediction scheme for components subject to HCF that is superior to the modified Goodman diagram approach currently employed by the US Air Force.
DTIC
Fretting; Finite Element Method; Fracture Mechanics; Fatigue (Materials); Aircraft Structures; Coffin-Manson Law; Structural Failure

19990019708 University of South Florida, Dept. of Civil and Environmental Engineering, Tampa, FL USA
Update of the Starship Fuselage Finite Element Model Using Modal Data
Hassiotis, Sophia, University of South Florida, USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 67; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

An accurate analytical model of the Beechcraft Starship fuselage is needed to design the acoustic response in the main cabin of the aircraft. The initial dynamic response produced by a finite element model did not agree with measured data. This is due to the complexity of the aircraft. In this project, numerous parameters were identified and updated to achieve agreement between the analytical and measured response. The Starship is a new 10-passenger aircraft with a unique all-composite construction. The composite consists of a honeycomb which is sandwiched on either side by four graphite epoxy plies. Aluminum stiffeners, reinforcements placed on the floor and around windows, and an unknown distribution of the mass added to the overall complexity of the structure. An initial MSC/NASTRAN finite element model produced errors in the natural frequencies in excess of 40% of those measured in laboratory tests. In addition, the weight of the aircraft given by the model was 449 lbs less than measured. First, the model was updated to correct the amount and distribution of mass. Examination of core samples indicated that two additional composite plies needed to be included in the main cabin area. IN addition, weight was added to compensate for paint, rivets, epoxy, and concentrated masses. Finally, the thickness of each ply was increased to account for numerical error in measurement. The updates added the necessary weight. Parameters which defined the structural stiffness were modified to produce better agreement between model and measured frequencies. Namely, the elastic constants he composite were changed to more accurately reflect the values found in the literature. The mass and stiffness updates produced a model which predicted the natural frequencies measured in the laboratory.
Author
Graphite-Epoxy Composites; Honeycomb Structures; Passenger Aircraft; Mathematical Models; Finite Element Method; Elastic Properties; Epoxy Resins; Dynamic Response

19990019857 NASA Langley Research Center, Hampton, VA USA
Engineering Overview of a Multidisciplinary HSCT Design Framework Using Medium-Fidelity Analysis Codes
Weston, R. P., NASA Langley Research Center, USA; Green, L. L., NASA Langley Research Center, USA; Salas, A. O., NASA Langley Research Center, USA; Samareh, J. A., NASA Langley Research Center, USA; Townsend, J. C., NASA Langley Research Center, USA; Walsh, J. L., NASA Langley Research Center, USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 133-134; In English; See also 19990019831; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche; Abstract Only; Abstract Only

An objective of the HPCC Program at NASA Langley has been to promote the use of advanced computing techniques to more rapidly solve the problem of multidisciplinary optimization of a supersonic transport configuration. As a result, a software system has been designed and is being implemented to integrate a set of existing discipline analysis codes, some of them CPU-intensive, into a distributed computational framework for the design of a High Speed Civil Transport (HSCT) configuration. The proposed paper will describe the engineering aspects of integrating these analysis codes and additional interface codes into an automated design system. The objective of the design problem is to optimize the aircraft weight for given mission conditions, range, and payload requirements, subject to aerodynamic, structural, and performance constraints. The design variables include both thicknesses of structural elements and geometric parameters that define the external aircraft shape. An optimization model has been adopted that uses the multidisciplinary analysis results and the derivatives of the solution with respect to the design variables to formulate a linearized model that provides input to the CONMIN optimization code, which outputs new values for the design variables. The analysis process begins by deriving the updated geometries and grids from the baseline geometries and grids using the

new values for the design variables. This free-form deformation approach provides internal FEM (finite element method) grids that are consistent with aerodynamic surface grids. The next step involves using the derived FEM and section properties in a weights process to calculate detailed weights and the center of gravity location for specified flight conditions. The weights process computes the as-built weight, weight distribution, and weight sensitivities for given aircraft configurations at various mass cases. Currently, two mass cases are considered: cruise and gross take-off weight (GTOW). Weights information is obtained from correlations of data from three sources: 1) as-built initial structural and non-structural weights from an existing database, 2) theoretical FEM structural weights and sensitivities from Genesis, and 3) empirical as-built weight increments, non-structural weights, and weight sensitivities from FLOPS. For the aeroelastic analysis, a variable-fidelity aerodynamic analysis has been adopted. This approach uses infrequent CPU-intensive non-linear CFD to calculate a non-linear correction relative to a linear aero calculation for the same aerodynamic surface at an angle of attack that results in the same configuration lift. For efficiency, this nonlinear correction is applied after each subsequent linear aero solution during the iterations between the aerodynamic and structural analyses. Convergence is achieved when the vehicle shape being used for the aerodynamic calculations is consistent with the structural deformations caused by the aerodynamic loads. to make the structural analyses more efficient, a linearized structural deformation model has been adopted, in which a single stiffness matrix can be used to solve for the deformations under all the load conditions. Using the converged aerodynamic loads, a final set of structural analyses are performed to determine the stress distributions and the buckling conditions for constraint calculation. Performance constraints are obtained by running FLOPS using drag polars that are computed using results from non-linear corrections to the linear aero code plus several codes to provide drag increments due to skin friction, wave drag, and other miscellaneous drag contributions. The status of the integration effort will be presented in the proposed paper, and results will be provided that illustrate the degree of accuracy in the linearizations that have been employed.
Author
Aircraft Design; Multidisciplinary Design Optimization; Design Analysis; Iterative Solution; Applications Programs (Computers); Software Engineering; Finite Element Method

19990019864 Computer Sciences Corp., Hampton, VA USA
An Object Oriented Framework for HSCT Design
Sistla, Raj, Computer Sciences Corp., USA; Dovi, Augustine R., Computer Sciences Corp., USA; Su, Philip, Computer Sciences Corp., USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 171-176; In English; See also 19990019831; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

Aircraft design is inherently iterative in nature and multidisciplinary in composition. The process is complicated by the fact that the focus and approach of each discipline can be quite distinct, and multiple invocations of the discipline programs are required to arrive at a feasible design. The usual result is a design procedure that is largely inflexible and computationally taxing. An earlier effort within the Framework for Interdisciplinary Design and Optimization (FIDO) project used Parallel Virtual Machine (PVM) to handle communications between discipline codes executing in a "host/slave" mode. This framework was sensitive to the host operating system and changing the analytical connectivity or switching discipline codes required major programming intervention. The goal of the current framework is to provide a proorammning environment for automating the distribution of a complex computing task over a networked, heterogeneous system of computers. These computers may include: engineering workstations, vector supercomputers, and parallel-processing computers. They work on their individual parts of the design, in parallel whenever possible, and have access to centralized data. Each computational task is assigned to the most appropriate computer type. The present framework provides a means for automating the overall design process. It provides communication and control between components, which include the diverse discipline computations in a design problem and the system services facilitating the design.
Derived from text
Multidisciplinary Design Optimization; Aircraft Design; Computer Techniques; Programming Environments; Object-Oriented Programming; Computer Networks; Design Analysis

19990021055 Isothermal Community Coll., Spindale, NC USA
Harnessing the Brute: The Development of Propulsion Controlled Aircraft at NASA Dryden
Tucker, Tom, Isothermal Community Coll., USA; Oct. 1998; 3p; In English; See also 19990021025; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

PCA, Performance Control Aircraft, is a backup flight control system for use when an airplane has lost all its hydraulics and normal flight controls. PCA is an autopilot system which modulates the thrust of the engines to provide lateral and longitudinal direction and enables the pilots to land the airplane. NASA Dryden has developed this technology in flight, ground simulator, and analytic studies which started as early as 1989. NASA Dryden has combined efforts with NASA Ames, McDonnell Aerospace St. Louis, Douglass Aircraft Long Beach, Honeywell, Pratt & Whitney, the US Air Force, and the US Navy to develop PCA to the point where it is feasible to bring a commercial airliner not just to a survivable crash landing but to a normal landing. The

purpose of my project was to develop a history of an invention which evolved by group problem-solving. My focus was not on validations arrived at -- these are already documented in technical reports -- but on the inventive process. I have previously published work about individual inventors and their processes, one of these studies concerning Philo Farnsworth's Image Dissector, the crucial invention for all-electronic television. The Image Dissector history concerns the classic lone inventor scenario. But PCA is the history of often reconfigured teams developing an invention in our modern environment governed by complex commercial and regulatory units, a story of, as one engineer put it, "how you push a good idea through the system."
Author
Automatic Pilots; Electronic Equipment; Flight Control; Flight Simulators

06
AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

19990019125 Smiths Industries Aerospace and Defense Systems, Inc., Grand Rapids Div., Grand Rapids, MI USA
Navy F/A-18 Crash Survivable Flight Incident Recorder (CSFIR)
Nov. 23, 1998; 30p; In English
Contract(s)/Grant(s): N00019-98-F-0016
Report No.(s): AD-A357658; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

On 17-18 November 1998 Representatives from the Navy, Boeing and Smiths Industries met at the Naval Air Weapons Development Center, China Lake, CA. The objective of this meeting was to provide an update on this program including the Program Overview, Task Description, Deliverable Items, Schedule, Status of the Interface Control Document, Software Design, System Test Plans, Software Requirement Specification Review. In addition to the briefing material, the following items were discussed: 1. Since the proposed F/A-18 CSFIR installation does not include a download connector, the existing AN/AUQ-76A will not work without incorporating a different interface cabling scheme. Bill Parillo requested SI provide informal schematics for such an interface cable for the following two configurations: (SI action item #7) * The AN/AUQ-76A interfaces to the CSFIR on the aircraft. * The AN/AUQ-76A interfaces to the CSFIR off the aircraft and on the bench. 2. Bill Parillo asked China Lake how long they would need the CSFIR VADR
DTIC
Computer Programs; Interfaces; Flight Recorders; Automatic Control; Crashes

07
AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

19990019165 NASA Langley Research Center, Hampton, VA USA
Static Performance of a Wing-Mounted Thrust Reverser Concept
Asbury, Scott C., NASA Langley Research Center, USA; Yetter, Jeffrey A., NASA Langley Research Center, USA; 1998; 19p; In English; 34th; Propulsion, 13-15 Jul. 1998, Cleveland, OH, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 98-3256; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

An experimental investigation was conducted in the Jet-Exit Test Facility at NASA Langley Research Center to study the static aerodynamic performance of a wing-mounted thrust reverser concept applicable to subsonic transport aircraft. This innovative engine powered thrust reverser system is designed to utilize wing-mounted flow deflectors to produce aircraft deceleration forces. Testing was conducted using a 7.9%-scale exhaust system model with a fan-to-core bypass ratio of approximately 9.0, a supercritical left-hand wing section attached via a pylon, and wing-mounted flow deflectors attached to the wing section. Geometric variations of key design parameters investigated for the wing-mounted thrust reverser concept included flow deflector angle and chord length, deflector edge fences, and the yaw mount angle of the deflector system (normal to the engine centerline or parallel to the wing trailing edge). All tests were conducted with no external flow and high pressure air was used to simulate core and fan engine exhaust flows. Test results indicate that the wing-mounted thrust reverser concept can achieve overall thrust reverser effectiveness levels competitive with (parallel mount), or better than (normal mount) a conventional cascade thrust reverser system. by removing the thrust reverser system from the nacelle, the wing-mounted concept offers the nacelle designer more options

for improving nacelle aerodynamics and propulsion-airframe integration, simplifying nacelle structural designs, reducing nacelle weight, and improving engine maintenance access.
Author
Experimentation; Aerodynamic Characteristics; Subsonic Speed; Structural Design; Scale Models; Transport Aircraft; Supercritical Wings; Thrust Reversal

19990019324 NASA Lewis Research Center, ClevelandOH USA
Study of Boundary Layer Development in a Two-Stage Low-Pressure Turbine
Dorney, Daniel J., Virginia Commonwealth Univ., USA; Ashpis, David E., NASA Lewis Research Center, USA; Halstead, David E., General Electric Co., USA; Wisler, David C., General Electric Co., USA; Feb. 1999; 28p; In English; 37th; Aerospace Sciences, 11-14 Jan. 1999, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): NCC3-645; RTOP 523-26-33
Report No.(s): NASA/TM-1999-208913; E-11544; AIAA Paper 99-0742; NAS 1.15:208913; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Experimental data from jet-engine tests have indicated that unsteady blade row interactions and separation can have a significant impact on the efficiency of low-pressure turbine stages. Measured turbine efficiencies at takeoff can be as much as two points higher than those at cruise conditions. Several recent studies have revealed that Reynolds number effects may contribute to the lower efficiencies at cruise conditions. In the current study numerical simulations have been performed to study the boundary layer development in a two-stage low-pressure turbine, and to evaluate the transition models available for low Reynolds number flows in turbomachinery. The results of the simulations have been compared with experimental data, including airfoil loadings and integral boundary layer quantities. The predicted unsteady results display similar trends to the experimental data, but significantly overestimate the amplitude of the unsteadiness. The time-averaged results show close agreement with the experimental data.
Author
Jet Engines; Two Stage Turbines; Computerized Simulation; Baldwin-Lomax Turbulence Model; Boundary Layer Transition; Transition Flow; Flow Visualization; Boundary Layer Separation; Separated Flow; Rotor Blades (Turbomachinery)

19990019479 NASA Lewis Research Center, Cleveland, OH USA
Analysis of Inlet-Compressor Acoustic Interactions Using Coupled CFD Codes
Suresh, A., DYNACS Engineering Co., Inc., USA; Townsend, S. E., DYNACS Engineering Co., Inc., USA; Cole, G. L., NASA Lewis Research Center, USA; Slater, J. W., NASA Lewis Research Center, USA; Chima, R., NASA Lewis Research Center, USA; December 1998; 14p; In English; 37th; Aerospace Sciences, 11-14 Jan. 1999, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): NAS3-98008; RTOP 509-10-11
Report No.(s): NASA/TM-1998-208839; NAS 1.15:208839; AIAA Paper 98-0749; E-11451; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A problem that arises in the numerical simulation of supersonic inlets is the lack of a suitable boundary condition at the engine face. In this paper, a coupled approach, in which the inlet computation is coupled dynamically to a turbomachinery computation, is proposed as a means to overcome this problem. The specific application chosen for validation of this approach is the collapsing bump experiment performed at the University of Cincinnati. The computed results are found to be in reasonable agreement with experimental results. The coupled simulation results could also be used to aid development of a simplified boundary condition.
Author
Computational Fluid Dynamics; Turbomachinery; Supersonic Inlets; Unsteady Aerodynamics

19990019480 NASA Lewis Research Center, Cleveland, OH USA
Engine Technology Challenges for the High-Speed Civil Transport Plane
Plencner, Robert M., NASA Lewis Research Center, USA; Misra, Ajay, NASA Lewis Research Center, USA; Graber, Edwin J., Jr., NASA Lewis Research Center, USA; Shaw, Robert J., NASA Lewis Research Center, USA; Seng, Gary T., NASA Lewis Research Center, USA; December 1998; 20p; In English; 20th; Advanced Measurement and Ground Testing Technology, 15-18 Jun. 1998, Albuquerque, NM, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): RTOP 537-05-23
Report No.(s): NASA/TM-1998-208405; E-11238; NAS 1.15:208405; AIAA Paper 98-2505; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Ongoing NASA-funded and privately funded studies continue to indicate that an opportunity exists for a second generation supersonic commercial airliner, or High-Speed Civil Transport (HSCT), to become a key part of the 21 st century international

air transportation system. Long distance air travel is projected to be the fastest growing segment of the air transportation market by the turn of the century with increases at about 5 percent per annum over the next two decades. This projection suggests that by the year 2015, more than 600,000 passengers per day will be traveling long distances, predominantly over water. These routes would provide the greatest potential for an HSCT to become a significant part of the international air transportation system. The potential market for an HSCT is currently projected to be anywhere from 500-1500 aircraft over the 2005-2030 time period. Such an aircraft fleet size would represent a considerable share of the potential long-range aircraft market. However, this projected HSCT fleet can become a reality only if technologies are developed which will allow an HSCT design that is (1) environmentally compatible and (2) economically viable. Simply stated, the HSCT will be a technology driven airplane. Without significant advances in airframe and propulsion technologies over the levels currently available, there will be no second generation supersonic airliner! This paper will briefly describe the propulsion technology challenges which must be met prior to any product launch decision being made by industry and the progress toward meeting these challenges through NASAs High-Speed Research (HSR) Program, a partnership between NASA and Boeing, General Electric and Pratt & Whitney.
Author
Supersonic Transports; Air Transportation; Propulsion; Airframes

19990019847 NASA Lewis Research Center, Cleveland, OH USA
3D Multistage Simulation of Each Component of the GE90 Turbofan Engine
Turner, Mark, General Electric Co., USA; Topp, Dave, General Electric Co., USA; Veres, Joe, NASA Lewis Research Center, USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 87; In English; See also 19990019831; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche; Abstract Only; Abstract Only

A 3D multistage simulation of each component of the GE90 Turbofan engine has been made. This includes 49 blade rows. A coupled simulation of all blade rows will be made very soon. The simulation is running using two levels of parallelism. The first level is on a blade row basis with information shared using files. The second level is using a grid domain decomposition with information shared using MPI. Timings will be shown for running on the SP2, an SGI Origin and a distributed system of HP workstations. On the HP workstations, the CHIMP version of MPI is used, with queuing supplied by LSF (Load Sharing Facility). A script-based control system is used to ensure reliability. An MPEG movie illustrating the flow simulation of the engine has been created using PV3, a parallel visualization library created by Bob Haimes of MIT. PVM is used to create a virtual machine from 10 HP workstations and display on an SGI workstation. A representative component simulation will be compared to rig data to demonstrate its usefulness in turbomachinery design and analysis.
Author
Turbofan Engines; Engine Design; Engine Parts; Computerized Simulation; Parallel Processing (Computers); Distributed Processing

19990019848 ASE Technologies, Inc., Cincinnati, OH USA
Application of Multi-Stage Viscous Flow CFD Methods for Advanced Gas Turbine Engine Design and Development
Subramanian, S., ASE Technologies, Inc., USA; Vitt, Paul, ASE Technologies, Inc., USA; Cherry, David, General Electric Co., USA; Turner, Mark, General Electric Co., USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 89-90; In English; See also 19990019831; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche; Abstract Only; Abstract Only

The primary objective of the research is to develop, apply and demonstrate the capability and accuracy of 3-D multi-stage CFD methods as efficient design tools on high-performance computer platforms, for the development of advanced gas turbine engines. Propulsion systems that are planned and that are currently in development for next generation civilian and military aircraft applications under NASA's Advanced Subsonic Technology (AST), DoD's Integrated High Performance Turbine Engine Technology (IHPTET) programs will be required to operate under complex flow conditions, imposed by strict performance expectations and goals. Some of the expectations and goals include higher thrust, lower emission levels, higher pressure ratios, smaller size, lower weight, fewer stages, lower fuel consumption and higher efficiency. These goals necessitate blades with high turning angles, stages with small axial gaps between blade rows, and non-axisymmetric flowpath. It becomes important to use design methods that treat the stator and rotor airfoils as a complete system for providing information regarding the influence of one blade row on the other for overall engine performance. The particular aspect of this very complex problem that is presently of interest to NASA and to US Aircraft Engine companies, and the focal point of this research is the prediction and understanding of the 3-D multi-stage interaction effects in advanced gas turbine engines. More importantly, to use the information for design optimization and performance improvements in next generation engines to power US commercial and military aircraft. Using the HPCCP computational resources, several 3-D multi-stage aerodynamic analyses were performed for high pressure and low pressure turbine designs under flight and rig conditions. Results are presented here for a Boeing 777 class, high and low pressure turbine engine stage configuration at take-off conditions. The analysis included cooling flow addition details and effects of seal leaks through

both turbine stages to realistically represent the actual engine operation. The turbine geometry consisted of 18 blade rows, that were solved simultaneously due to fully subsonic flow conditions. Using the parallel version of the average passage code and with a total of 9.4 million grid points, results were obtained using typically 16 to 60 processors. Load balancing the processors between blade rows provided good parallel efficiency. The overall agreement of the rig analysis with experimental data was very good, providing confidence in the average passage solution approach. The HPCCP computational resource was an excellent testbed for these real world simulations, and very good parallel performance efficiencies were achieved for these complex flow analyses.
Author
Computational Fluid Dynamics; Gas Turbine Engines; Engine Design; Propulsion System Configurations; Propulsion System Performance; Optimization; Viscous Flow; Parallel Processing (Computers)

19990019858 Allison Engine Co., Indianapolis, IN USA
Turbine Engine HP/LP Spool Analysis
Hall, Edward J., Allison Engine Co., USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 137-142; In English; See also 19990019831; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The primary objective of this task is to develop and demonstrate the capability to analyze the aerodynamics in the complete high pressure (HP) and low pressure (LP) subsystems of both the NASA/General Electric (GE) Energy Efficient Engine (EEE) and the Allison AE3007 engine using three-dimensional Navier-Stokes numerical models. The analysis will evaluate the impact of steady aerodynamic interaction effects between the components of the HP and LP subsystems. The computational models shall be developed from the geometric components contained in the HP and LP subsystems including: engine nacelle, inlet, fan blades, bifurcated bypass and core inlet, bypass vanes, core inlet guide vanes, booster stage, core compressor blades, high pressure turbine blades, low pressure turbine blades, mixer, and exhaust nozzle. Predictions will be obtained using the ADPAC aerodynamic analysis code. The analysis shall be performed and optimized for workstation cluster computing platforms using parallel processing techniques. The concept of "zooming" in the analysis shall be demonstrated by substituting a lower order cycle model of the HP or LP subsystems using results from the National Cycle Program (NCP). Ultimately, the analysis will include the effects of operation at angle of attack by modeling a complete rotation of the fan wheel.
Author
Gas Turbine Engines; Three Dimensional Models; Parallel Processing (Computers); Navier-Stokes Equation; Mathematical Models; Engine Design; Aerodynamic Characteristics; Computerized Simulation

19990019865 NASA Lewis Research Center, Cleveland, OH USA
National Cycle Program (NCP) Common Analysis Tool for Aeropropulsion
Follen, G., NASA Lewis Research Center, USA; Naiman, C., NASA Lewis Research Center, USA; Evans, A., NASA Lewis Research Center, USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 177-181; In English; See also 19990019831; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

Through the NASA/Industry Cooperative Effort (NICE) agreement, NASA Lewis and industry partners are developing a new engine simulation, called the National Cycle Program (NCP), which is the initial framework of NPSS. NCP is the first phase toward achieving the goal of NPSS. This new software supports the aerothermodynamic system simulation process for the full life cycle of an engine. The National Cycle Program (NCP) was written following the Object Oriented Paradigm (C++, CORBA). The software development process used was also based on the Object Oriented paradigm. Software reviews, configuration management, test plans, requirements, design were all apart of the process used in developing NCP. Due to the many contributors to NCP, the stated software process was mandatory for building a common tool intended for use by so many organizations. The U.S. aircraft and airframe companies recognize NCP as the future industry standard for propulsion system modeling.
Derived from text
Computerized Simulation; Engine Design; Programming Environments; Applications Programs (Computers); Computer Techniques

19990021018 Syracuse Univ., Dept. of Mechanical, Aerospace, and Manufacturing Engineering, NY USA
A Computer Investigation of a Lobed-Mixer Fuel-Injection Strut in a Scramjet Engine Model *Final Report, Jun. 1994 - Jun. 1997*
Campuzano, Mario Felipe, Syracuse Univ., USA; Dang, Thong Q., Syracuse Univ., USA; May 1997; 98p; In English; Original contains color illustrations
Contract(s)/Grant(s): NGT-70380; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche

A method of enhancing fuel/air mixing using streamwise vorticity for scramjet applications is presented. The generation of large-scale streamwise vortices is achieved by the incorporation of a lobed-mixer device into the fuel-injection struts of a proposed

NASA scramjet engine. Conceptually, the lobed-mixer strut design is a three-dimensional lifting surface with a sinusoidal spanwise lift distribution. In the flow passage between the strut leading- and trailing-edges, the presence of a spanwise pressure gradient generates secondary flows. In the region behind the strut, which is a lifting surface, the shed vorticity system consists of periodic large-scale counter-rotating streamwise vortices. to evaluate this hypermixer concept, CFD calculations were carried out at supersonic combustor inlet Mach numbers ranging from 2 to 3 for cold flows. This concept is first analyzed for a 3D cascade of struts in inviscid flows. Results from this preliminary work reveal that significant secondary flows are generated in and behind the strut regions, while the additional shock losses associated with the lobed strut is small. Results confirm that the mechanism of generating streamwise vorticity is an inviscid phenomenon; the shed vorticity (i.e. streamwise vorticity) behind the strut is proportional to the pressure loading along the strut (Kutta-Joukowsky theorem). The next stage of this investigation considers the effects of viscosity on the generation of streamwise vorticity (or secondary flow). The geometry considered is a single lobed strut with "slip" side walls. Here, the NASA Reynolds-Averaged Navier-Stokes LARCK code (Langley Algorithm for Research in Chemical Kinetics) was used. Relative to the inviscid-flow results, in the absence of flow separation, viscous effects introduce blockage into the flow passage, causing a small reduction in pressure loading and hence a slight reduction in secondary flow. In the presence of flow separation, the strut pressure loading can be significantly reduced, resulting in a large reduction in secondary flow. Next, the effect of Mach number on the strength of the streamwise vorticity is investigated. For the configuration studied, the pressure loading along the strut (hence the magnitude of secondary flow) was found to be a strong function of the strength and angle of the leading-edge shocks, which depends on the inflow Mach number. Finally, preliminary experimental verification of this hypermixer concept was carried out. Flow visualizations confirm the presence of strong large-scale streamwise vortices downstream of the strut.
Author
Supersonic Combustion Ramjet Engines; Fuel Injection; Flow Visualization; Secondary Flow; Supersonic Inlets; Trailing Edges; Vorticity; Reynolds Averaging; Pressure Gradients; Leading Edges

08
AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

19990019364 NASA Dryden Flight Research Center, Edwards, CA USA
Flight-Determined, Subsonic, Lateral-Directional Stability and Control Derivatives of the Thrust-Vectoring F-18 High Angle of Attack Research Vehicle (HARV), and Comparisons to the Basic F-18 and Predicted Derivatives
Iliff, Kenneth W., NASA Dryden Flight Research Center, USA; Wang, Kon-CASISheng Charles, Sparta, Inc., USA; January 1999; 90p; In English
Contract(s)/Grant(s): RTOP 529-50-04-00-RR
Report No.(s): NASA/TP-1999-206573; NAS 1.60:206573; H-2252; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The subsonic, lateral-directional, stability and control derivatives of the thrust-vectoring F-1 8 High Angle of Attack Research Vehicle (HARV) are extracted from flight data using a maximum likelihood parameter identification technique. State noise is accounted for in the identification formulation and is used to model the uncommanded forcing functions caused by unsteady aerodynamics. Preprogrammed maneuvers provided independent control surface inputs, eliminating problems of identifiability related to correlations between the aircraft controls and states. The HARV derivatives are plotted as functions of angles of attack between 10deg and 70deg and compared to flight estimates from the basic F-18 aircraft and to predictions from ground and wind tunnel tests. Unlike maneuvers of the basic F-18 aircraft, the HARV maneuvers were very precise and repeatable, resulting in tightly clustered estimates with small uncertainty levels. Significant differences were found between flight and prediction; however, some of these differences may be attributed to differences in the range of sideslip or input amplitude over which a given derivative was evaluated, and to differences between the HARV external configuration and that of the basic F-18 aircraft, upon which most of the prediction was based. Some HARV derivative fairings have been adjusted using basic F-18 derivatives (with low uncertainties) to help account for differences in variable ranges and the lack of HARV maneuvers at certain angles of attack.
Author
F-18 Aircraft; Angle of Attack; Maximum Likelihood Estimates; Directional Stability; Control Surfaces; Aircraft Control

19990019379 NASA Langley Research Center, Hampton, VA USA
Estimation of Aircraft Nonlinear Unsteady Parameters From Wind Tunnel Data
Klein, Vladislav, Joint Inst. for Advancement of Flight Sciences, USA; Murphy, Patrick C., NASA Langley Research Center, USA; December 1998; 43p; In English
Contract(s)/Grant(s): RTOP 522-33-11-05
Report No.(s): NASA/TM-1998-208969; NAS 1.15:208969; L-17805; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Aerodynamic equations were formulated for an aircraft in one-degree-of-freedom large amplitude motion about each of its body axes. The model formulation based on indicial functions separated the resulting aerodynamic forces and moments into static terms, purely rotary terms and unsteady terms. Model identification from experimental data combined stepwise regression and maximum likelihood estimation in a two-stage optimization algorithm that can identify the unsteady term and rotary term if necessary. The identification scheme was applied to oscillatory data in two examples. The model identified from experimental data fit the data well, however, some parameters were estimated with limited accuracy. The resulting model was a good predictor for oscillatory and ramp input data.
Author
Wind Tunnel Tests; Unsteady Aerodynamics; Aerodynamic Forces; Mathematical Models; Aircraft Stability; Flight Stability Tests

19990019404 Florida Univ., Dept. of Electrical and Computer Engineering, Gainesville, FL USA
Application of Robust Control and Gain Scheduling to Missile Autopilot Design *Final Report, 1 Aug. 1994 - 31 Jan. 1996*
Bullock, T. E.; Fields, S. L.; Sep. 01, 1998; 116p; In English
Contract(s)/Grant(s): DAAH04-94-G-0276
Report No.(s): AD-A357847; ARO-32865.1-MA; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The problem of gain scheduling LPV systems is studied and applied to missile autopilot design. Necessary and sufficient conditions for determining the Quadratic stabilizing of LPV systems are given. A stabilizing LPV controller is found if one exists. The necessary and sufficient conditions are realistically computable with reduced dimension and with only the elements of the Lyapunov matrix P as the unknown variables. The quadratic Stability results are then extended to the more general case of General Lyapunov stability. The derivation is the same as for Quadratic stability, except there is an additional term that is a function of the derivative of the Lyapunov function. An algorithm is presented that will solve these new conditions. Finally two methods for finding minimal/near minimal realizations for 2-D systems is presented. The first method requires extracting any greatest common divisors out of a nominimal realization and then returning the realization back to state-space form. This method does not extend to N-D systems. However the second method, the System Equivalent Based method, can be extended to N-D systems. This method begins with the LPV system description being converted to Rosenbreock's system matrix form. Then the system matrix form is systematically manipulated until it is in state-space form.
Author
Scheduling; Automatic Pilots; Aircraft Design; Matrices (Mathematics); Robustness (Mathematics)

19990019435 NASA Dryden Flight Research Center, Edwards, CA USA
Flight Test of an Adaptive Configuration Optimization System for Transport Aircraft
Gilyard, Glenn B., NASA Dryden Flight Research Center, USA; Georgie, Jennifer, NASA Dryden Flight Research Center, USA; Barnicki, Joseph S., NASA Dryden Flight Research Center, USA; January 1999; 14p; In English; 37th; Aerospace Sciences, 11-14 Jan. 1999, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): RTOP 522-16-14-00-39
Report No.(s): NASA/TM-1999-206569; NAS 1.15:206569; H-2284; AIAA Paper 99-0831; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A NASA Dryden Flight Research Center program explores the practical application of real-time adaptive configuration optimization for enhanced transport performance on an L-1011 aircraft. This approach is based on calculation of incremental drag from forced-response, symmetric, outboard aileron maneuvers. In real-time operation, the symmetric outboard aileron deflection is directly optimized, and the horizontal stabilator and angle of attack are indirectly optimized. A flight experiment has been conducted from an onboard research engineering test station, and flight research results are presented herein. The optimization system has demonstrated the capability of determining the minimum drag configuration of the aircraft in real time. The drag-minimization algorithm is capable of identifying drag to approximately a one-drag-count level. Optimizing the symmetric outboard aileron position realizes a drag reduction of 2-3 drag counts (approximately 1 percent). Algorithm analysis of maneuvers indicate that two-sided raised-cosine maneuvers improve definition of the symmetric outboard aileron drag effect, thereby improving analysis results and consistency. Ramp maneuvers provide a more even distribution of data collection as a function of excitation deflection

than raised-cosine maneuvers provide. A commercial operational system would require airdata calculations and normal output of current inertial navigation systems; engine pressure ratio measurements would be optional.
Author
Adaptive Control; Aircraft Performance; Cambered Wings; Transport Aircraft; Flight Tests; Data Acquisition; Angle of Attack; Aerodynamic Drag

19990019462 Utah Univ., Dept. of Mechanical Engineering, Salt Lake City, UT USA
Output Tracking with Nonhyperbolic and Near Nonhyperbolic Internal Dynamics: Helicopter Hover Control
Devasia, Santosh, Utah Univ., USA; Journal of Guidance, Control, and Dynamics; May 1997; Volume 20, No. 3, pp. 573-580; In English
Contract(s)/Grant(s): NAG2-1042; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

A technique to achieve output tracking for nonminimum phase linear systems with nonhyperbolic and near nonhyperbolic internal dynamics is presented. This approach integrates stable inversion techniques, which achieve exact tracking, with approximation techniques, which modify the internal dynamics, to achieve desirable performance. Such modification of the internal dynamics is used: (1) to remove nonhyperbolicity, which is an obstruction to applying stable inversion techniques; and (2) to reduce large preactuation times needed to apply stable inversion for near nonhyperbolic cases. The method is applied to an example helicopter hover control problem with near nonhyperbolic internal dynamics for illustrating the tradeoff between exact tracking and reduction of preactuation time.
Author
Helicopter Control; Hovering; Stability; Linear Systems

19990019659 Virginia Polytechnic Inst. and State Univ., Dept. of Mechanical Engineering, Blacksburg, VA USA
Variable Store Flutter Suppression (AASERT) ***Final Report, 15 Jun. 1995 - 14 Jun 1998***
Inman, Daniel J.; Sep. 09, 1998; 25p; In English
Contract(s)/Grant(s): F49620-95-1-0426
Report No.(s): AD-A356048; AFRL-SR-BL-TR-98-0686; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The objectives for this three year program where (a) to design and develop mechanics models for a novel "large stroke" piezoceramic actuator, and (b) examine the usefulness of this actuator for solving the store induced flutter problem. In particular our goal has been to formulate predictive models that would be useful in the design and commercialization of such actuators.
DTIC
Actuators; Flutter; Piezoelectric Ceramics; Acoustic Attenuation; Vibration Damping

19990019716 Old Dominion Univ., Dept. of Aerospace Engineering, Norfolk, VA USA
Autoparametric Control of Helicopter Ground Resonance
Kunz, Donald L., Old Dominion Univ., USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 76; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

This research focused on using autoparametric absorbers and saturation control to suppress helicopter ground resonance. In virtually every helicopter, ground resonance instabilities are eliminated by incorporating lag dampers in the rotor design to dissipate the energy transferred to the lag motion of the blades when the regressing cyclic lag and rigid-body fuselage modes coalesce. In addition to the blade dampers, it is frequently necessary to incorporate dampers in the landing gear of the aircraft, in order to obtain sufficient energy dissipation. The benefit of replacing the blade-mounted lag dampers with autoparametric absorbers would be to significantly reduce the weight and drag penalty associated with the dampers. In this investigation, the equations of motion used to model ground resonance were based on the classical equations derived by Coleman and Feingold. Only the minimum number of degrees of freedom were retained, including fuselage longitudinal translation, rotor cosine cyclic lag and rotor sine cyclic lag motions. Three absorber equations were then appended to the ground resonance equations, one for each degree of freedom; and they were coupled to the fuselage equation with quadratic nonlinear terms. The design of the absorbers required an analytical solution of these six, simultaneous, nonlinear, ordinary differential equations. The method of multiple scales was used to obtain the solution. Obtaining a solution for the equations, and therefore a design for the absorbers, presented difficulties not previously encountered in applications of this type of absorber. First, because of the Coriolis coupling between the rotor lag degrees of freedom, there is no set of principal coordinates that will result in a set of uncoupled natural modes for the system. Second, because of the comparatively large number of equations needed to model ground resonance and the absorbers, the solutions of the equations became very complex and cumbersome. The solutions of the first-order equations were obtained quite easily, since the rotor equations were not coupled to the three, independent absorber equations. However, the analytical solutions to the rotor/fuselage

equations were extremely complex. The solution of the second-order equations presented some difficulties that have yet to be resolved. The fundamental question is how to represent the natural rotor/fuselage modes in the absorber equations. It would be easier to make the coupling implicit by introducing three modal variables, but this approach might not lead to an adequate consideration of the coupling in the second-order solution. The alternative leads to a very complex set of equations. In short, additional work will be required before an adequate design for the absorbers can be obtained.
Author
Helicopters; Uncoupled Modes; Nonlinear Equations; Landing Gear; Ground Resonance; Fuselages; Energy Dissipation; Degrees of Freedom

19990019832 Rensselaer Polytechnic Inst., Troy, NY USA
Adaptive Computation of Rotor-Blades in Hover
Dindar, Mustafa, Rensselaer Polytechnic Inst., USA; Kenwright, David, MRJ Technology Solutions, USA; Jansen, Ken, Rensselaer Polytechnic Inst., USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 3-8; In English; See also 19990019831; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

An adaptive refinement procedure is developed for computing vortical flows encountered in rotor aerodynamics. For this purpose, an error indicator based on interpolation error estimate is formulated and coded into an adaptive finite element framework. It is shown that the error indicator based on interpolation error estimate is effective in resolving the global features of the flow-field. Furthermore, for efficiency and problem size considerations, once the interpolation errors are reduced to acceptable levels, the adaptive refinement is done only in regions affected by the vortical flows. to do this a novel vortex core detection technique is used to capture vortex tubes. The combination of interpolation error estimate and vortex core detection technique proved to be very effective in computing vortical flow-field of rotor blades. Using this two-level adaptive refinement procedure the UH-60A BlackHawk rotor is analyzed in hover flow conditions.
Author
Error Detection Codes; Rotor Aerodynamics; Iterative Solution; Vortices; Systematic Errors; Interpolation; Finite Element Method; Computational Grids; Flow Distribution

09
RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

19990019705 Rochester Inst. of Tech., Dept. of Mechanical Engineering, NY USA
Implementation of TWNTN4A at the 0.3 Meter Transonic Cryogenic Tunnel
Ghosh, Amitabha, Rochester Inst. of Tech., USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 63; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

TWNTN4A is a nonlinear, transonic, small disturbance code for correcting wall interference effects in 2-D wind tunnels. Incorporated into this potential flow solver is the capability to account for the important effects of the boundary layer growths on the wind tunnel sidewalls. The original TWINTAN code was developed about 20 years ago for post-test use; however, improved computer technology now allows on-line implementation. The object of this research is to implement the code in the test cycle and enhance capabilities of the 0.3 m. Transonic Cryogenic Tunnel (TCT) at NASA-Langley. TWNTN4A has three calculation cycles - tunnel calculations, free-air calculations and perturbation flow calculations. The tunnel calculations are an inverse design procedure to generate an effective inviscid body using the tunnel wall pressure measurements as boundary conditions with the free stream velocity and Mach number the same as the experimental test case. The effective inviscid body shape which produces the same blockage effect (drag coefficients) then undergoes the second cycle of calculation. In this cycle the flow of free-air is calculated around the equivalent shape while the angle of attack is corrected to satisfy the Kutta condition for lift corresponding to the tunnel flow. During the convergence process, the far field velocity and Mach number are upgraded using an optimization algorithm which tries to match the free-airflow pressure distribution around the airfoil. When the second cycle is complete the correction quantities for angle of attack and Mach number are available. However to determine further the effect of the model and wall effects, a third cycle is run which solves the free- air flow with the singularity distribution obtained in the first cycle and the corrected free- stream conditions obtained from the second. Wall effects are the difference between the total perturbation from the first cycle and model perturbations from the second. The focus of this work was to convert a research code into a production code, streamline the process where possible, prepare on-line documentation, upgrade input and output capabili-

ties and deliver a single code for different operating systems. The program which used to take several hours for convergence in the old system now runs under 10 seconds in the DEC Alpha system available at TCT. Thus, TWNTN4A will be available for real-time data correction for future tests. Additionally, new TECPLOT plotting capabilities which are readily available on multiple systems have been added. New and extensive documentation adds comments on program variables and input requirements. Future directions of this research will include comparison of several testing runs with Navier-Stokes calculations. A major interest in this research is to determine the exact effect of free-stream flow angularity. Since wind tunnel test sections are finite in size the effects on flow angularity may not be fully correctable. Shock wave boundary layer interaction is another phenomenon which will limit the capabilities of TWNTN4A. Testing with different size models must be conducted to assess program limitations.
Author
Cryogenics; Wind Tunnel Tests; Transonic Wind Tunnels; Shock Wave Interaction; Navier-Stokes Equation; Kutta-Joukowski Condition; Aerodynamic Interference; Aerodynamic Coefficients; Airfoils

19990019709 Christopher Newport Univ., Dept. of Physics, Computer Science and Engineering, Newport News, VA USA
TIGER MANE: Thermally-Induced Gradient Effects Research, Model Analysis and Nontransferability Evaluation
Hereford, James, Christopher Newport Univ., USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 68; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

When wind tunnel measurements are made at non-ambient temperatures (e.g., at the National Transonic Facility), temperature differences on the measurement balance cause a strain that affects the measured load on the model. The strain from the thermal gradient affects all six measurements but its greatest impact is on the axial force (drag) measurement. (Current NTF balances have uncorrected thermal effects of approximately 1% of the full scale component load.) Correction of the thermal gradient effects requires a timely and expensive conditioning process. The goals of this program are to (a) understand the physics of the thermally-induced strain and its subsequent impact on load measurements and (b) develop a robust thermal gradient compensation algorithm. The net effect will be more accurate and precise data, more efficient use of the N'IT, and an overall cost savings to NASA. One part of the TIGER program is a Model Assessment and Nontransferability Evaluation (MANE). The goal of MANE is to determine the model for how the temperature gradients affect the strain measurements. In addition, it is important to understand why a model that works well for lab data does not work well when an aircraft model is on the balance (transferability evaluation). The first step was to evaluate a wide assortment of mathematical models to determine how combine the (nine) temperature measurements into a prediction of the output of the axial force. Several models were considered: linear, sin, exponential, natural log, 2d order models and several autoregressive moving average (ARMA) models which take into account past data samples. The ARMA models worked great but are impractical to implement in real-life wind tunnel applications because they would also cancel out a constant applied force. Hence, after considering 14 different models and almost 11,000,000 test cases, we determined a linear combination of temperature sensors gives the best approximation of axial force output. Data analysis from a standard balance with nine temperature sensors does not lead directly to an applicable thermal gradient compensation algorithm. Thus, physical affects of then-nal gradients were considered. From the physical affects, two possible compensation techniques have been determined. The first technique, the front-back technique, determines the impact on the axial force output of a thermal gradient from the front of the balance to the back. (A similar analysis shows that left to right thermal gradients will have no affect on axial force output). The resulting front-back thermal gradient equation gives a clear technique to correct for the gradient once certain key temperatures are known. The second technique, the thermomechanical technique, looks at how thermal gradients will affect the flex beams on the balance. For the simple gradients considered, there is a large difference between how the flex beams deflect when subjected to thermal gradients versus when they are subjected to an applied force. Monitoring the flex beams, therefore, could lead to a thermal gradient compensation technique. to verify these techniques, data from a special research balance must be obtained.
Author
Thermodynamics; Temperature Sensors; Temperature Measurement; Temperature Gradients; Temperature Effects; Drag Measurement; Autoregressive Moving Average; Aircraft Models

19990019723 Christopher Newport Univ., Dept. of Physics, Computer Science and Engineering, Newport News, VA USA
Interface Properties of MEMS Sensors on Airfoil
Selim, Raouf, Christopher Newport Univ., USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 83; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

One of the primary goals of wind tunnel groups at NASA Langley Research Center is to reduce wind tunnel cycle time and cost while improving data quality collected during the tests. The objective of the Advanced Model Instrumentation Technology (AMIT) program is to develop a prototype in-model instrumentation system that can be retrofitted into existing models or inte-

grated in new models at the time of their design. The program has three major components: 1) Micro Electro Mechanical Systems (MEMS) sensors (shear stress, pressure, temperature and Angle of attack). 2) In-model electronics (Data acquisition systems and signal conditioning). 3) Data transfer capabilities (Fiber optic or telemetry). MEMS sensors are micron-to-millimeter scale devices with moving parts or containing fluids, fabricated using semiconductor technologies and often directly connected or integrated with ICs. MEMS Sensor Design covers three areas: 1) Layout and process of the sensor itself. 2) Circuitry for interfacing the system with the sensor. 3) The package that will fit the MEMS sensor into an application. The purpose of this study is to characterize the mechanical interface of MEMS sensors mounted on the surface of the model and test the packaging design under simulated conditions (normal stress, vibration, etc ...). The study included two types of MEMS sensors, namely pressure sensors and shear stress sensors. A measurement system was developed for characterizing the sensors under normal strain and at different temperatures. Each sensor was mounted on a specially designed cantilever beam that has a maximum strain of 1000 micro in/in. The output voltage of the MEMS pressure sensor was measured as a function of applied static pressure and the strain on the beam (at different temperatures). The resistance of four different resistors on the shear stress sensor was measured as a function of the strain on the beam (also at different temperatures). The resistance of four different resistors on the shear stress sensor was measured as a function of the strain on the beam (also at different temperatures). Results of the experiment show that change in the output voltage of the pressure sensor due to strain is less than 80 microvolt and is less than 0.1% of FSO. One can conclude that the strain on the beam has minimal effect on the output of the pressure sensor. Resistance values of the shear stress sensor' resistors increase with the increase in strain. More measurements need to be done to further characterize the relationship between shear stress sensor output and strain on the airfoil. Future studies also may include the effect of pressure and temperature on shear stress sensors.
Author
Airfoils; Angle of Attack; Cantilever Beams; Data Acquisition; Fabrication; Fiber Optics; Microelectromechanical Systems; Millimeter Waves

19990019726 Hampton Univ., School of Business, VA USA
Paving the Way for the Wind Tunnel Enterprise at NASA Langley Research Center
Siegfeldt, Denise V., Hampton Univ., USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 86; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

The Wind Tunnel Enterprise (WTE) at Langley Research Center (LaRC) is a virtual organization comprised of nine Divisions: Aero- and Gas-Dynamics, Facilities & Systems Support, Experimental Testing Technology, Facility Systems Engineering, Information Systems and Services, Fabrication, Fluid Mechanics and Acoustics, and Structures. Wind tunnel facilities within the WTE include the National Transonic Facility and the 0.3M Cryogenic Tunnel. The WTE was envisioned as an organization that would apply business-like principles to its operations and the way in which customers are handled. Strategic planning for the WTE was based upon the cooperative efforts of customers, stakeholders, and producers/ operators of LaRC's wind tunnels. Due to intense global competition, external customers of the wind tunnels had voiced concern that the test cycle time was too long, which delayed the time for new products to reach the market. They were also concerned about the quality of data that they were receiving. Concerns of internal customers were also taken into consideration. WTE's mission is to "provide reliable, accurate research information to the aeronautical community in a timely manner. to accomplish this requires a focus on increasing productivity, cost-effective operations, technical support that adds value, and the development of new facility capability and test techniques." There are many technical, operational, cultural and management goals for the WTE. These goals are designed to enable the WTE to have a positive influence on the bottom-line; namely, increased productivity, data quality, customer satisfaction and employee satisfaction, and decreased cost and cycle time. A major component of the WTE is the proposed Wind Tunnel University (WTU). WTU was the focus of this project and is linked to the VTM cultural goals. The project involved creating a framework for the identification of core competencies (i.e., Tunnel Operations and Wind Tunnel Information Technology) and associated skills through involvement of the WTE Curriculum Committee and interviews with LARC administrators, researchers and technicians. A Gap Analysis Survey was designed to examine gaps that exist between the skills of WTE employees today verses those that are needed. The survey was fine-tuned through use of an electronic meeting with researchers and technicians who are subject matter experts. The survey will be administered through a Web site designed to assure anonymity to individual respondents. Future skill requirements due to cutting edge technologies and those on the horizon will also be identified. Results will provide a snapshot view of the state of the WTE today in terms of employee skills and will suggest the types of training needed. Experts' description's of the skills will be used to develop a course catalog for WTE training at LARC. Metrics will be created to measure the success of each training program. The VITU will serve as a national model for wind tunnel training and is projected to serve outside customers and govenunent agencies in the future.
Author
Wind Tunnels; Systems Engineering; Information Systems; Fluid Mechanics; Gas Dynamics

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ENGINEERING

Includes engineering (general); communications and radar; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

19990019403 Massachusetts Inst. of Tech., Cambridge, MA USA
A Microfabricated Motor-Compressor for Fuel Cell Applications *Final Report, 16 Jun. 1996 - 14 Jun. 1998*
Ayon, A.; Breuer, K.; Chen, K.-CASIS.; Ehrich, F.; Frechette, L.; Aug. 1998; 106p; In English
Contract(s)/Grant(s): DAAH04-96-1-0256
Report No.(s): AD-A357845; ARO-35749.2-CH; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This effort is directed at research leading to microfabricated motor driven compressors suitable far the pressurization of fuel cells in the 50-150 watt range and microblowers (lower pressure rise, high air flows) for instrument aspiration. Micromachined from silicon, these are high power microelectrical and mechanical systems (MEMS). The design performance for the compressor is pumping 0.1 g/sec of air at a pressure ratio of 2:1 while consuming approximately 15-20 watts of electrical power.
DTIC
Turbomachinery; Microelectromechanical Systems; Micromachining; Fabrication; Compressors

19990019718 New Jersey Inst. of Tech., Dept. of Chemical Engineering, Newark, NJ USA
Turbulent Jet in a Coflowing Stream
Loney, Norman W., New Jersey Inst. of Tech., USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 78; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

The testing of aircraft models in a wind tunnel is a mature technology at Langley Research Center. However, the issue of mixing the fuel and an oxygen rich stream in the 8 Ft. High Temperature tunnel is not quite resolved. There are many approaches that can accomplish the task (mixing a hot and cold fluid), but several of those schemes are not suitable for this unique testing facility. Therefore a theoretical investigation is underway to develop a model of a two dimensional turbulent jet in a coflowing stream. This incompressible jet flow will be modeled by employing an integral method which includes turbulent shear stress, entrainment and heat transfer. A commercially available computation fluid dynamics (CFD) code is being used to test the theory since experimental data will not be available from the tunnel. Essentially, one would like to predict the heat transfer to the wall as a function of the jet proximity to that wall, given the size, velocity direction and energy level of the jet.
Author
Aircraft Models; Computational Fluid Dynamics; Energy Levels; Heat Transfer; Incompressible Flow; Turbulence; Turbulent Jets; Wind Tunnel Models

19990019729 Old Dominion Univ., Dept. of Mechanical Engineering, Norfolk, VA USA
Detection and Measurement of Hidden Corner Cracks Using a Portable NDI Probe
Williamson, Keith M., Old Dominion Univ., USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 89; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

Fatigue damage in aircraft structures increase as airplanes are operated beyond their economic design life, typically 20,000 flight cycles. Reduced durability and safety of these aging structures require elaborate inspection and maintenance to ensure continued airworthiness. Cyclic pressure tests on fuselage structures similar to those found on commercial airliners have enabled researchers to characterize the various forms of fatigue damage. These characterizations show the progression of fuselage skin fatigue cracks from the initial stages of multisite damage (MSD) through crack linkup and widespread fatigue damage (WSFD). Detailed tear down examination and fractography of the lap splice joints have revealed crack initiation sites, crack morphology, and crack linkup geometry. Results of these studies have allowed researchers to benchmark critical laboratory simulations, analytical predictions and advanced nondestructive inspection techniques. Ultimately, the goal is to develop analytical models for estimating the fatigue life of aging structures subject some form of MSD. The quality of analytical models relate directly to types and sizes of cracks which characterize MSD. Although nondestructive inspection (NDI) provides excellent means for detecting flaws, results do not provide data on flaw sizes which are important for characterizing MSD. Generally, NDI results are used to determine

the need for repair or to justify airworthiness. Consequently, field data on the sizes of flaws which may define MSD is lacking. The approach used in this investigation is to determine if MSD can be quantified using field data from NDI. During experiments, data will be recorded for quarter-elliptical corner cracks grown from circular holes in 0.63 inch thick aluminum 2024-T3 specimens. After countersinking holes and riveting specimens to hide fatigue crack damage, a portable NDI probe will be used to detect hidden cracks and establish relationships between NDI results and known crack length data.
Author
Aircraft Structures; Aluminum Alloys; Commercial Aircraft; Corners; Countersinking; Crack Geometry; Crack Initiation; Crack Propagation; Lap Joints

19990019859 NASA Ames Research Center, Moffett Field, CA USA
Parallel Aeroelastic Analysis Using ENSAERO and NASTRAN
Eldred, Lloyd B., MCAT Inst., USA; Byun, Chansup, MCAT Inst., USA; Guruswamy, Guru P., NASA Ames Research Center, USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 143-147; In English; See also 19990019831
Contract(s)/Grant(s): NAS2-14109; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

A high fidelity parallel static structural analysis capability is created and interfaced to the multidisciplinary analysis package ENSAERO-MPI of Ames Research Center. This new module replaced ENSAERO's lower fidelity simple finite element and modal modules. Full aircraft structures may be more accurately modeled using the new finite element capability. Parallel computation is performed by breaking the full structure into multiple substructures. This approach is conceptually similar to ENSAERO's multi-zonal fluid analysis capability. The new substructure code is used to solve the structural finite element equations for each substructure in parallel. NASTRAN/COSMIC is utilized as a front end for this code. Its full library of elements can be used to create an accurate and realistic aircraft mode. It is used to create the stiffness matrices for each sub-structure. The new parallel code then uses an iterative preconditioned conjugate gradient method to solve the global structural equations for the sub-structure boundary nodes. Results are presented for a wing-body configuration.
Author
Structural Analysis; Multidisciplinary Design Optimization; Parallel Processing (Computers); Nastran; Computer Techniques; Computation; Body-Wing Configurations; Aeroelasticity

19990019860 NASA Ames Research Center, Moffett Field, CA USA
Performance and Applications of ENSAERO-MPI on Scalable Components
Farhangnia, Mehrdad, MCAT Inst., USA; Guruswamy, Guru, NASA Ames Research Center, USA; Byun, Chansup, Sun Microsystems, Inc., USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 149-150; In English; See also 19990019831; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

The latest improvements and results generated by ENSAERO-MPI are presented in this paper. ENSAERO-MPI is a parallelized, high-fidelity, multi-block code with fluids, structures and controls capabilities developed at NASA Ames Research Center under the support of HPCC. It is capable of multidisciplinary simulations by simultaneously integrating the Navier-Stokes equations, the finite element structural equations as well as control dynamics equations using aeroelastically adaptive, patched grids. Improvements have been made to the code's robustness, moving grid capabilities and performance.
Derived from text
Parallel Processing (Computers); Computerized Simulation; Applications Programs (Computers); Navier-Stokes Equation; Multidisciplinary Design Optimization; Aircraft Design; Aircraft Configurations

19990019861 NASA Ames Research Center, Moffett Field, CA USA
OVERAERO-MPI: Parallel Overset Aeroelasticity Code
Gee, Ken, MCAT Inst., USA; Rizk, Yehia M., NASA Ames Research Center, USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 151-156; In English; See also 19990019831; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

An overset modal structures analysis code was integrated with a parallel overset Navier-Stokes flow solver to obtain a code capable of static aeroelastic computations. The new code was used to compute the static aeroelastic deformation of an arrow-wing-body geometry and a complex, full aircraft configuration. For the simple geometry, the results were similar to the results obtained with the ENSAERO code and the PVM version of OVERAERO. The full potential of this code suite was illustrated in the complex, full aircraft computations.
Derived from text
Aeroelasticity; Structural Analysis; Navier-Stokes Equation; Computerized Simulation; Parallel Processing (Computers); Aircraft Configurations; Static Deformation; Applications Programs (Computers)

19990019867 NASA Lewis Research Center, Cleveland, OH USA
Inlet-Compressor Analysis using Coupled CFD Codes
Cole, Gary, NASA Lewis Research Center, USA; Suresh, Ambady, DYNACS Engineering Co., Inc., USA; Townsend, Scott, DYNACS Engineering Co., Inc., USA; HPCCP/CAS Workshop Proceedings 1998; Jan. 1999, pp. 189-195; In English; See also 19990019831; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

Propulsion performance and operability are key factors in the development of a successful aircraft. For high-speed supersonic aircraft, mixed-compression inlets offer high performance but are susceptible to an instability referred to as unstart. An unstart occurs when a disturbance originating in the atmosphere or the engine causes the shock system to be expelled from the inlet. This event can have adverse effects on control of the aircraft, which is unacceptable for a passenger plane such as the high speed civil transport (HSCT). The ability to predict the transient response of such inlets to flow perturbations is, therefore, important to the proper design of the inlet and the control measures used to prevent unstart. Computational fluid dynamics (CFD) is having an increasing role in the analysis of individual propulsion components. Isolated inlet studies are relatively easy to perform, but a major uncertainty is the boundary condition used at the inlet exit to represent the engine - the so-called compressor face boundary condition. A one-dimensional (1-D) Euler inlet simulation showed that the predicted inlet unstart tolerance to free-stream pressure perturbations can vary by as much as a factor of about six, depending on the boundary condition used. Obviously a thorough understanding of dynamic interactions between inlets and compressors/fans is required to provide the proper boundary condition. to aid in this understanding and to help evaluate possible boundary conditions, an inlet-engine experiment was conducted at the University of Cincinnati. The interaction of acoustic pulses, generated in the inlet, with the engine were investigated. Because of the availability of experimental data for validation, it was decided to simulate the experiment using CFD. The philosophy here is that the inlet-engine system is best simulated by coupling (existing) specialized CFD component-codes. The objectives of this work were to aid in a better understanding of inlet-compressor interaction physics and the formulation of a more realistic compressor-face boundary condition for time-accurate CFD simulations of inlets. Previous simulations have used 1-D Euler engine simulations in conjunction with 1-D Euler and axisymmetric Euler inlet simulations. This effort is a first step toward CFD simulation of an entire engine by coupling multidimensional component codes.
Derived from text
Engine Inlets; Supersonic Compressors; Computational Fluid Dynamics; Flow Stability; Boundary Conditions; Pressure Oscillations; Computerized Simulation; Applications Programs (Computers)

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GEOSCIENCES

Includes geosciences (general); earth resources and remote sensing; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

19990019720 Cumberland Coll., Dept. of Mathematics, Physics and Geography, Williamsburg, KY USA
Organizing and Analyzing Lidar Data Obtained From the Contrails of a Boeing 737
Newquist, Lawrence A., Cumberland Coll., USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 80; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

With the production of the High Speed Civil Transport (HSCT) , which will fly in the stratosphere, comes a need to monitor the emissions from these aircraft. With the presence of the ozone layer at the top of the stratosphere, it is important to study the composition and evolution of these emissions as well as the circulation of these emissions throughout the stratosphere to understand their impact on the stratosphere and the ozone layer. In experiments carried out in 1995, 1996, and 1997, a 48 inch zenith Lidar (Light Detection and Ranging) system and a scanning Lidar system were used to detect the backscatter radiation from the contrails of a Boeing 737 jet aircraft as the plumes were advected across the Lidar systems. Radiation at wavelengths of 1064 nm and 532 nm was used on the 48 inch system. Only radiation at 1064 nm was used on the scanning system. This data needs to be processed and organized into a uniform format since the formats changed over the three years due to better ways to acquire and store the data. Also, for some runs, two lasers each running at 10 Hz were interleaved to generate 20 Hz data. Methods for correctly interleaving the two laser signals will be studied. The data then needs to be posted to the Web to make it available to the scientific community. Analysis of this data will include calculating the ratio of the 532 nm return to the 1064 nm return. This will be referred to as the beta ratio since it is essentially the ratio of the backscatter cross sections (typically symbolized using the Greek letter beta)

for the two wavelengths. Since small particles will scatter 532 nm radiation more efficiently then 1064 nm radiation a large beta ratio could be indicative of regions of small particle formation which could indicate interesting chemistry within the plume region.
Author
Boeing 737 Aircraft; Optical Radar; Lasers; Supersonic Transports

19990019894 Atmospheric and Environmental Research, Inc., Cambridge, MA USA
Transport Between the Tropical and Midlatitude Lower Stratosphere: Implications for Ozone Response to High Speed Civil Transport Emissions
Shia, R.-CASIL., Atmospheric and Environmental Research, Inc., USA; Ko, M. K. W., Atmospheric and Environmental Research, Inc., USA; Weisenstein, D. K., Atmospheric and Environmental Research, Inc., USA; Scott, C., Atmospheric and Environmental Research, Inc., USA; Rodriquez, J., Atmospheric and Environmental Research, Inc., USA; Journal of Geophysical Research; Oct. 20, 1998; ISSN 0148-0227; Volume 103, No. D19, pp. 25,435-25,446; In English
Contract(s)/Grant(s): NAS5-32371; NAS5-97039
Report No.(s): Paper-98JD01882; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Several recent studies have quantified the air exchange rate between the tropics and midlatitudes in the lower stratosphere using airborne and satellite measurements of chemical species. It is found that the midlatitude air is mixed into the tropical lower stratosphere with a replacement timescale of 13.5 months (with 20% uncertainty) for the region from the tropopause to 21 km and at least 18 months for the region of 20-28 km. These estimates are used to adjust the horizontal eddy diffusion coefficients, K(sub yy), in a two-dimensional chemistry transport model. The value of K(sub yy) previously used to simulate the subtropical barrier, 0.03 x 10(exp 6)sq m/s, generates an exchange time of about 4 years, and the model without subtropical barrier (K(sub yy) = 0.3 x 10(exp 6)sq m/s) has an exchange time of 5 months. Adjusting the K(sub yy) to 0.13 x 10(exp 6) sq m/s from the tropopause to 21 km and 0.07 x 10(exp 6)sq m/s above 21 km produces the exchange timescales which match the estimates deduced from the measurements. The subtropical barrier prevents the engine emissions of the high-speed civil transport (HSCT) aircraft from being transported into the tropics and subsequently lifted into the upper atmosphere or mixed into the southern hemisphere. The model results show that the calculated ozone response to HSCT aircraft emissions using the K(sub yy), adjusted to observed mixing rates is substantially smaller than that simulated without the subtropical barrier.
Author
Exhaust Emission; Supersonic Transports; Tropical Regions; Transport Aircraft; Exhaust Gases; Temperate Regions; Combustion Products; Ozone; Stratosphere

19990019895 NASA Goddard Space Flight Center, Greenbelt, MD USA
Aviation Fuel Tracer Simulation: Model Intercomparison and Implications
Danilin, M. Y., Atmospheric and Environmental Research, Inc., USA; Fahey, D. W., National Oceanic and Atmospheric Administration, USA; Schumann, U., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Prather, M. J., California Univ., USA; Penner, J. E., Michigan Univ., USA; Ko, M. K. W., Atmospheric and Environmental Research, Inc., USA; Weisenstein, D. K., Atmospheric and Environmental Research, Inc., USA; Jackman, C. H., NASA Goddard Space Flight Center, USA; Pitari, G., Aquila Univ., Italy; Koehler, I., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Sausen, R., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Weaver, C. J., NASA Goddard Space Flight Center, USA; Douglass, A. R., NASA Goddard Space Flight Center, USA; Connell, P. S., Lawrence Livermore National Lab., USA; Kinnison, D. E., Lawrence Livermore National Lab., USA; Dentener, F. J., Utrecht Univ., Netherlands; Fleming, E. L., NASA Goddard Space Flight Center, USA; Berntsen, T. K., Center for International Climate and Environmental Research, Norway; Isaksen, I. S. A., Oslo Univ., Norway; Geophysical Research Letters; Nov. 01, 1998; ISSN 0094-8276; Volume 25, No. 21, pp. 3947-3950; In English
Report No.(s): Paper-GRL-1998900058; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

An upper limit for aircraft-produced perturbations to aerosols and gaseous exhaust products in the upper troposphere and lower stratosphere (UT/LS) is derived using the 1992 aviation fuel tracer simulation performed by eleven global atmospheric models. Key findings are that subsonic aircraft emissions: (1) have not been responsible for the observed water vapor trends at 40degN; (2) could be a significant source of soot mass near 12 km, but not at 20 km; (3) might cause a noticeable increase in the background sulfate aerosol surface area and number densities (but not mass density) near the northern mid-latitude tropopause; and (4) could provide a global, annual mean top of the atmosphere radiative forcing up to +0.006 W/sq m and -0.013 W/sq m due to emitted soot and sulfur, respectively.
Author
Atmospheric Models; Aircraft Fuels; Aerosols; Perturbation; Combustion Products; Exhaust Emission; Simulation

19990021032 Clark Univ., Graduate School of Geography, Worcester, MA USA
High Resolution Airborne Digital Imagery for Precision Agriculture
Herwitz, Stanley R., Clark Univ., USA; Oct. 1998; 3p; In English; See also 19990021025; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The Environmental Research Aircraft and Sensor Technology (ERAST) program is a NASA initiative that seeks to demonstrate the application of cost-effective aircraft and sensor technology to private commercial ventures. In 1997-98, a series of flight-demonstrations and image acquisition efforts were conducted over the Hawaiian Islands using a remotely-piloted solar- powered platform (Pathfinder) and a fixed-wing piloted aircraft (Navajo) equipped with a Kodak DCS450 CIR (color infrared) digital camera. As an ERAST Science Team Member, I defined a set of flight lines over the largest coffee plantation in Hawaii: the Kauai Coffee Company's 4,000 acre Koloa Estate. Past studies have demonstrated the applications of airborne digital imaging to agricultural management. Few studies have examined the usefulness of high resolution airborne multispectral imagery with 10 cm pixel sizes. The Kodak digital camera integrated with ERAST's Airborne Real Time Imaging System (ARTIS) which generated multiband CCD images consisting of 6 x 106 pixel elements. At the designated flight altitude of 1,000 feet over the coffee plantation, pixel size was 10 cm. The study involved the analysis of imagery acquired on 5 March 1998 for the detection of anomalous reflectance values and for the definition of spectral signatures as indicators of tree vigor and treatment effectiveness (e.g., drip irrigation; fertilizer application).

Derived from text

High Resolution; Research Aircraft; Airborne Equipment; Imaging Techniques; Charge Coupled Devices

19990021035 Nevada Univ., Dept. of Civil Engineering, Las Vegas, NV USA
Proposed Wind Turbine Aeroelasticity Studies Using Helicopter Systems Analysis
Ladkany, Samaan G., Nevada Univ., USA; Oct. 1998; 3p; In English; See also 19990021025; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Advanced systems for the analysis of rotary wing aeroelastic structures (helicopters) are being developed at NASA Ames by the Rotorcraft Aeromechanics Branch, ARA. The research has recently been extended to the study of wind turbines, used for electric power generation Wind turbines play an important role in Europe, Japan & many other countries because they are non polluting & use a renewable source of energy. European countries such as Holland, Norway & France have been the world leaders in the design & manufacture of wind turbines due to their historical experience of several centuries, in building complex wind mill structures, which were used in water pumping, grain grinding & for lumbering. Fossil fuel cost in Japan & in Europe is two to three times higher than in the USA due to very high import taxes. High fuel cost combined with substantial governmental subsidies, allow wind generated power to be competitive with the more traditional sources of power generation. In the USA, the use of wind energy has been limited mainly because power production from wind is twice as expensive as from other traditional sources. Studies conducted at the National Renewable Energy Laboratories (NREL) indicate that the main cost in the production of wind turbines is due to the materials & the labor intensive processes used in the construction of turbine structures. Thus, for the US to assume world leadership in wind power generation, new lightweight & consequently very flexible wind turbines, that could be economically mass produced, would have to be developed [4,5]. This effort, if successful, would result in great benefit to the US & the developing nations that suffer from overpopulation & a very high cost of energy.

Author

Wind Turbines; Aeroelasticity; Rotary Wings; Research; Rotary Wing Aircraft

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MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

19990019552 Rockwell Collins, Inc., Advanced Technology Center, Cedar Rapids, IA USA
Detecting Mode Confusion Through Formal Modeling and Analysis ***Final Report***
Miller, Steven P., Rockwell Collins, Inc., USA; Potts, James N., Rockwell Collins, Inc., USA; Jan. 1999; 69p; In English
Contract(s)/Grant(s): NAS1-19704; RTOP 522-33-31-01
Report No.(s): NASA/CR-1999-108971; NAS 1.26:208971; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Aircraft safety has improved steadily over the last few decades. While much of this improvement can be attributed to the introduction of advanced automation in the cockpit, the growing complexity of these systems also increases the potential for the pilots to become confused about what the automation is doing. This phenomenon, often referred to as mode confusion, has been

involved in several accidents involving modern aircraft. This report describes an effort by Rockwell Collins and NASA Langley to identify potential sources of mode confusion through two complementary strategies. The first is to create a clear, executable model of the automation, connect it to a simulation of the flight deck, and use this combination to review of the behavior of the automation and the man-machine interface with the designers, pilots, and experts in human factors. The second strategy is to conduct mathematical analyses of the model by translating it into a formal specification suitable for analysis with automated tools. The approach is illustrated by applying it to a hypothetical, but still realistic, example of the mode logic of a Flight Guidance System.
Author
Human Factors Engineering; Detection; Man Machine Systems; Flight Control; Methodology; Computer Programs

19990019667 NASA Goddard Space Flight Center, Greenbelt, MD USA
Evolving the Reuse Process at the Flight Dynamics Division (FDD) Goddard Space Flight Center
Condon, S., Computer Sciences Corp., USA; Seaman, C., Maryland Univ., USA; Basili, Victor, Maryland Univ., USA; Kraft, S., NASA Goddard Space Flight Center, USA; Kontio, J., Maryland Univ., USA; Kim, Y., Maryland Univ., USA; Software Engineering Laboratory Series: Proceedings of the Twenty-First Annual Software Engineering Workshop; Dec. 1996, pp. 27-58; In English; See also 19990019665; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper presents the interim results from the Software Engineering Laboratory's (SEL) Reuse Study. The team conducting this study has, over the past few months, been studying the Generalized Support Software (GSS) domain asset library and architecture, and the various processes associated with it. In particular, we have characterized the process used to configure GSS-based attitude ground support systems (AGSS) to support satellite missions at NASA's Goddard Space Flight Center. to do this, we built detailed models of the tasks involved, the people who perform these tasks, and the interdependencies and information flows among these people. These models were based on information gleaned from numerous interviews with people involved in this process at various levels. We also analyzed effort data in order to determine the cost savings in moving from actual development of AGSSs to support each mission (which was necessary before GSS was available) to configuring AGSS software from the domain asset library. While characterizing the GSS process, we became aware of several interesting factors which affect the successful continued use of GSS. Many of these issues fall under the subject of evolving technologies, which were not available at the inception of GSS, but are now. Some of these technologies could be incorporated into the GSS process, thus making the whole asset library more usable. Other technologies are being considered as an alternative to the GSS process altogether. In this paper, we outline some of issues we will be considering in our continued study of GSS and the impact of evolving technologies.
Author
Software Engineering; Computer Programs; Computer Programming; Aerodynamics; Software Reuse

19990019681 Naval Research Lab., Center for High Assurance Computer Systems, Washington, DC USA
Applying the SCR Requirements Specification Method to Practical Systems: A Case Study
Bharadwaj, Ramesh, Naval Research Lab., USA; Heitmeyer, Connie, Naval Research Lab., USA; Software Engineering Laboratory Series: Proceedings of the Twenty-First Annual Software Engineering Workshop; Dec. 1996, pp. 353-376; In English; See also 19990019665; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

Studies have shown that the majority of errors in software systems are due to incorrect requirements specifications. The root cause of many requirements errors is the imprecision and ambiguity that arise because the software requirements are expressed in natural language. An effective way to reduce such errors is to express requirements in a formal notation. For a number of years, researchers at the Naval Research Laboratory (NRL) have been working on a formal method based on tables to specify the requirements of practical systems. Known as the Software Cost Reduction (SCR) method, this approach was originally formulated to document the requirements of the Operational Flight Program (OFP) for the U.S. Navy's A-7 aircraft. Since SCR's introduction more than a decade ago, many industrial organizations, including Lockheed, Grumman, and Ontario Hydro, have used SCR to specify requirements. Recently, NRL has developed both a formal state machine model to define the SCR semantics and a set of software tools to support analysis and validation of SCR requirements specifications. The tools support consistency and completeness checking, simulation, and model checking.
Derived from text
A-7 Aircraft; Computer Programming; Computer Programs; Natural Language (Computers); Simulation; Software Engineering

19990019697 Purdue Univ., School of Aeronautics and Astronautics, West Lafayette, IN USA
Genetic Algorithm Actuator Placement for Flow Control for Maneuverability
Crossley, William A., Purdue Univ., USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 54; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

The Aircraft Morphing program is an effort to develop smart devices for aircraft applications, making use of active component technologies. One of the technology areas for this program is Multidisciplinary Design Optimization (MDO), and a focus effort in MDO is to investigate and subsequently develop methods for optimal placement of sensors and actuators for aeroelastic control, flow control and acoustic control. A promising approach for actuator placement is the Genetic Algorithm (GA), a global optimization technique well suited to discrete optimization. Smart devices that can produce a quasi-static shape change in an aircraft wing may be able to provide three-axis flight control; this could eliminate the need for conventional control surfaces. Surfaces like ailerons, flaps, etc., have gaps between the wing and the surfaces that contribute to leakage and protuberance drag and can be a source of aerodynamic noise. The focus of this study was to investigate GA approaches to place discrete actuators on a wing to provide three- axis flight control. The genetic algorithm is a computational representation of natural selection and reproduction observed in biological populations. The mimicry of nature in a GA includes representing points in a design space as if they were individual organisms. Design variables are generally mapped into binary strings that provide the genes of a given design. These strings are then concatenated to form a chromosome representing the traits of an individual design point. The GA works with these binary chromosomes, which allows for discrete optimization. In this application, the binary " I " represented an "on" actuator, while the "O" represented an "off ' actuator. A problem description was developed for a "three-condition" flight control design, where the number of unique actuators is to be minimized, subject to constraints on the pitch, roll and yaw moments. The first condition is a "pitch" condition where a limit is placed upon the pitching moment to reflect a pitch capability and limits are placed upon the magnitude of the roll and yaw moments to ensure that the pitching motion is uncoupled from roll and yaw. The other two conditions provide for uncoupled roll and yaw. The genetic algorithm determined actuator placements to meet the pitch condition for a simplified untapered, unswept wing. A 3-D panel code predicted aerodynamic force and moment coefficients for the various actuator placements. Results of this work have illustrated that the GA is suited to the task of actuator placement, and these results have highlighted areas for future research and development of this approach.
Author
Actuators; Aeroelasticity; Control Surfaces; Design Analysis; Flight Control; Multidisciplinary Design Optimization

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PHYSICS

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

19990019703 Midwestern State Univ., Wichita Falls, TX USA
Review and Extension of the Definition of the Acoustic Energy in Inhomogeneous Moving Media
Farris, Mark, Midwestern State Univ., USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 61; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

The acoustic energy in a moving inhomogeneous medium is a very useful tool for application to many problems of aeroacoustics such as ducted fans, helicopter rotors and high speed propellers. Intuitively, one expects that some conservation laws hold far an energy quantity. We could then use energy conservation laws to understand and control the noise level of these machines in the near and far fields. The concept of the acoustic energy in a moving medium is particularly useful in active noise control of ducted fan engines because the transducers used for noise control operate in a nonlinear flow regime. ne amount of energy needed by the transducers to affect the radiated noise of these engines can then be calculated precisely. The definition of acoustic energy in moving media is complicated because of the fact that there are three kinds of perturbation that propagate in inhomogeneous moving media. These are acoustic, vortical and entropic perturbations that travel at different speed in the fluid medium. Furthermore, the task of the definition of an acoustic energy expression is difficult because of the interaction between these three perturbation modes and the transfer of the acoustic energy to the mean flow. This investigation involves a review of the current state of the knowledge of the acoustic energy in inhomogeneous moving media. The basic energy conservation law is interpreted in several forms that may prove to be useful in isolating the acoustic energy and its interaction with the background flow.
Author
Acoustic Emission; Aeroacoustics; Conservation Laws; Energy Conservation; Near Fields; Noise Intensity; Noise Reduction; Rotary Wings; Sound Waves

19990021022 Virginia Polytechnic Inst. and State Univ., Vibration and Acoustics Labs., Blacksburg, VA USA
Hybrid Active-Passive Systems for Control of Aircraft Interior Noise *Final Report, 16 Jan. 1998 - 15 Jan. 1999*
Fuller, Chris R., Virginia Polytechnic Inst. and State Univ., USA; 1999; 3p; In English
Contract(s)/Grant(s): NCC1-282
Report No.(s): VPI/SU-FRS-4-26459; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Previous work has demonstrated the large potential for hybrid active-passive systems for attenuating interior noise in aircraft fuselages. The main advantage of an active-passive system is, by utilizing the natural dynamics of the actuator system, the control actuator power and weight is markedly reduced and stability/robustness is enhanced. Three different active-passive approaches were studied in the past year. The first technique utilizes multiple tunable vibration absorbers (ATVA) for reducing narrow band sound radiated from panels and transmitted through fuselage structures. The focus is on reducing interior noise due to propeller or turbo fan harmonic excitation. Two types of tunable vibration absorbers were investigated; a solid state system based upon a piezoelectric mechanical exciter and an electromechanical system based upon a Motran shaker. Both of these systems utilize a mass-spring dynamic effect to maximize tile output force near resonance of the shaker system and so can also be used as vibration absorbers. The dynamic properties of the absorbers (i.e. resonance frequency) were modified using a feedback signal from an accelerometer mounted on the active mass, passed through a compensator and fed into the drive component of the shaker system (piezoelectric element or voice coil respectively). The feedback loop consisted of a two coefficient FIR filter, implemented on a DSP, where the input is acceleration of tile ATVA mass and the output is a force acting in parallel with the stiffness of the absorber. By separating the feedback signal into real and imaginary components, the effective natural frequency and damping of the ATVA can be altered independently. This approach gave control of the resonance frequencies while also allowing the simultaneous removal of damping from the ATVA, thus increasing the ease of controllability and effectiveness. In order to obtain a "tuned" vibration absorber the chosen resonant frequency was set to the excitation frequency. In order to minimize sound radiation a gradient descent algorithm was developed which globally adapted the resonance frequencies of multiple ATVA's while minimizing a cost based upon the radiated sound power or sound energy obtained from an array of microphones.
Derived from text
Noise Reduction; Dynamic Characteristics; Aircraft Noise; Aircraft Compartments; Controllability

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SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law, political science, and space policy; and urban technology and transportation.

19990019690 Hampton Univ., VA USA
1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program
Marable, William P., Compiler, Hampton Univ., USA; Murray, Deborah B., Compiler, Old Dominion Univ., USA; Dec. 1998; 119p; In English; 34th, 1 Jun. - 7 Aug. 1998, Hampton, VA, USA; Sponsored by American Society for Engineering Education, USA; See also 19990019691 through 19990019729
Contract(s)/Grant(s): NGT1-52181
Report No.(s): NASA/CR-1998-208728; NAS 1.26:208728; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche; Abstracts Only; Abstracts Only

Since 1964, the National Aeronautics and Space Administration (NASA) has supported a program of summer faculty fellowships for engineering and science educators. In a series of collaborations between NASA research and development centers and nearby universities, engineering faculty members spend 10 weeks working with professional peers on research. The Summer Faculty Program Committee of the American Society for Engineering Education supervises the programs. The program objectives include: (1) to further the professional knowledge of qualified engineering and science faculty members; (2) to stimulate and exchange ideas between participants and NASA; (3) to enrich and refresh the research and teaching activities of participants' institutions; (4) To contribute to the research objectives of the NASA center. College or university faculty members will be appointed as Research Fellows to spend 10 weeks in cooperative research and study at the NASA Langley Research Center. The Fellow will devote approximately 90 percent of the time to a research problem and the remaining time to a study program. The study program will consist of lectures and seminars on topics of interest or that are directly relevant to the Fellows' research topics. The lecture and seminar leaders will be distinguished scientists and engineers from NASA, education, and industry.
Author
Aeronautical Engineering; NASA Programs; University Program; Conferences

19990019707 Christopher Newport Univ., Dept. of Physics and Computer Science, Newport News, VA USA
NASA Educator Workshop (NEW) Abstract
Hale, L. Vincent, Christopher Newport Univ., USA; 1998 NASA-HU American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program; Dec. 1998, pp. 66; In English; See also 19990019690; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

This summer 20 K-12 grade teachers traded in chalkboards, hall passes, and dismissal bells for wind tunnel tests, flight simulators, and aeronautic-related briefings as they attended a 2 week NASA Educator Workshop (NEW). The objectives of NEW were to share information about NASA resources, programs, and services, to provide an opportunity for the teams of educators to develop and implement an action plan that will support standards-based teaching and learning of science, mathematics, and technology in a problem-based learning (PBL) environment, to strengthen partnership with NASA by sustaining interaction and collaboration, and to provide an opportunity for the teams to exchange ideas.
Derived from text
Research and Development; NASA Programs; Flight Simulators; Education

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GENERAL

19990019751 Air Force Research Lab., Wright-Patterson AFB, OH USA
JAWS S3 98 Conference Las Vegas, NV 15-18 June 98 Volume 3
Jun. 1998; 496p; In English
Report No.(s): AD-A356185; No Copyright; Avail: CASI; A21, Hardcopy; A04, Microfiche

This report contains presentations from the JAWS S3 98 Conference. Topics include: (1) meeting technology needs of the warfighter Y2K and beyond, (2) embedded computer resources, (3) ordnance on target, (4) information technology and Naval aviation, (5) Army technology thrusts, (6) EW threat simulation, (7) ASW acoustic sensors, (8) software technology, (9) avionics, and (10) electronic combat.
DTIC
Conferences; Software Engineering; Avionics; Electronic Warfare

19990019752 Air Force Research Lab., Wright-Patterson AFB, OH USA
JAWS S3 98 Conference Las Vegas, NV 15-18 June 98 Volume 2
Jun. 1998; 427p; In English
Report No.(s): AD-A356186; No Copyright; Avail: CASI; A19, Hardcopy; A04, Microfiche

This report contains presentations from the JAWS S3 98 Conference. Topics include: (1) avionics, (2) EPA issues, (3) atmospheric support for ground systems hit avoidance, (4) target to sensor vision, (5) sensor vision in degraded environments, (6) electronic warfare testing, (7) computerized simulation, (8) cost reduction methods for aircraft weapon acquisition, (9) software engineering, (10) electronic protection radio, and (11) preflight integration of munitions and electronic systems.
DTIC
Conferences; Avionics; Software Engineering; Computerized Simulation; Target Acquisition; Weather

19990019753 Air Force Research Lab., Wright-Patterson AFB, OH USA
JAWS S3 98 Conference Las Vegas, NV 15-18 June 98 Volume 1
Jun. 1998; 391p; In English
Report No.(s): AD-A356187; No Copyright; Avail: CASI; A17, Hardcopy; A04, Microfiche

This report contains presentations from the JAWS S3 98 Conference. Topics include: (1) data compression, (2) fault tolerant computing, (3) partitioning protocol for systems integration, (4) relational avionics planning tool, (5) using RMA on an avionics product development life cycle, (6) legacy programs modeling and simulation, (7) information fusion, (8) SAR ATR algorithms, (9) software engineering, (10) electromagnetic radiation modeling, (11) real time embedded systems, (12) computer displays, and (13) distributed simulation testing.
DTIC
Conferences; Data Compression; Embedded Computer Systems; Computer Systems Design; Computer Programming; Fault Tolerance; Systems Integration; Avionics; Computerized Simulation

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